Aviation Week and Space Technology

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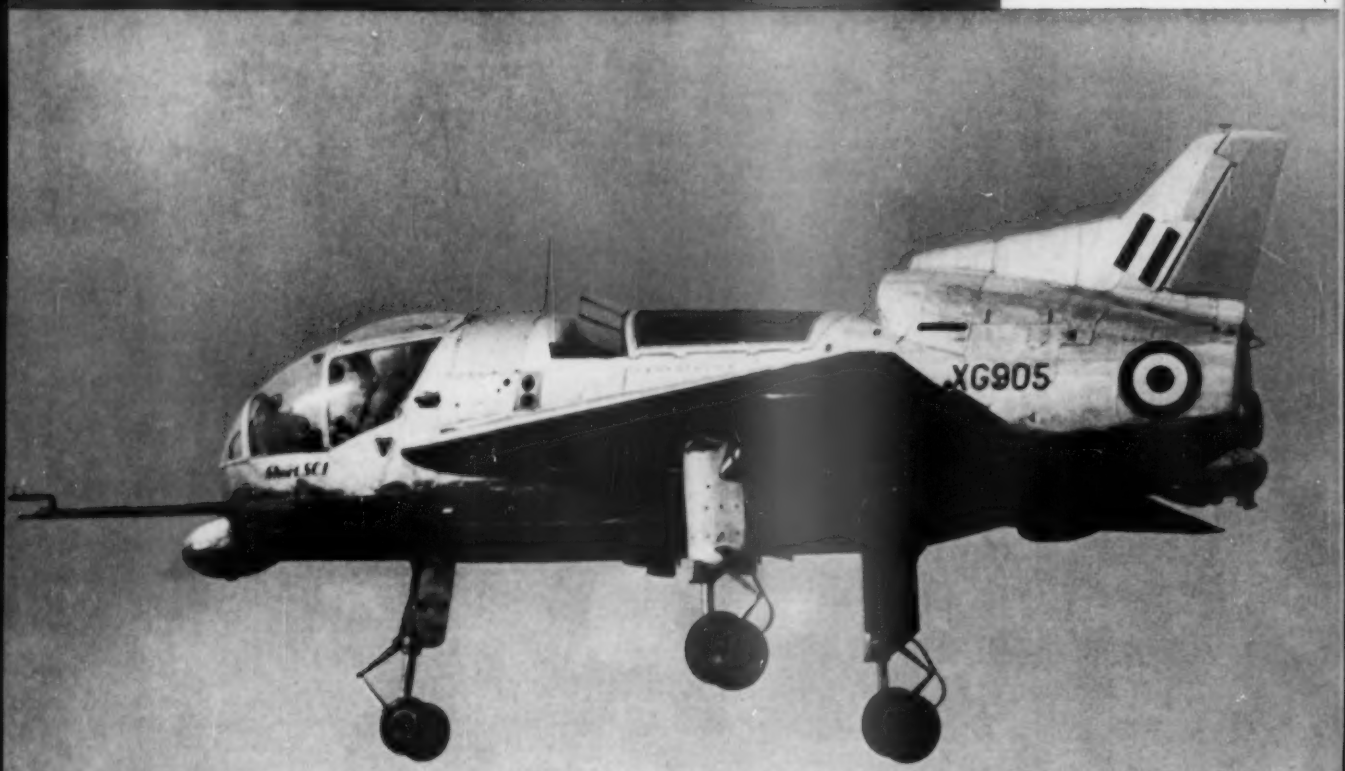
A McGraw-Hill Publication

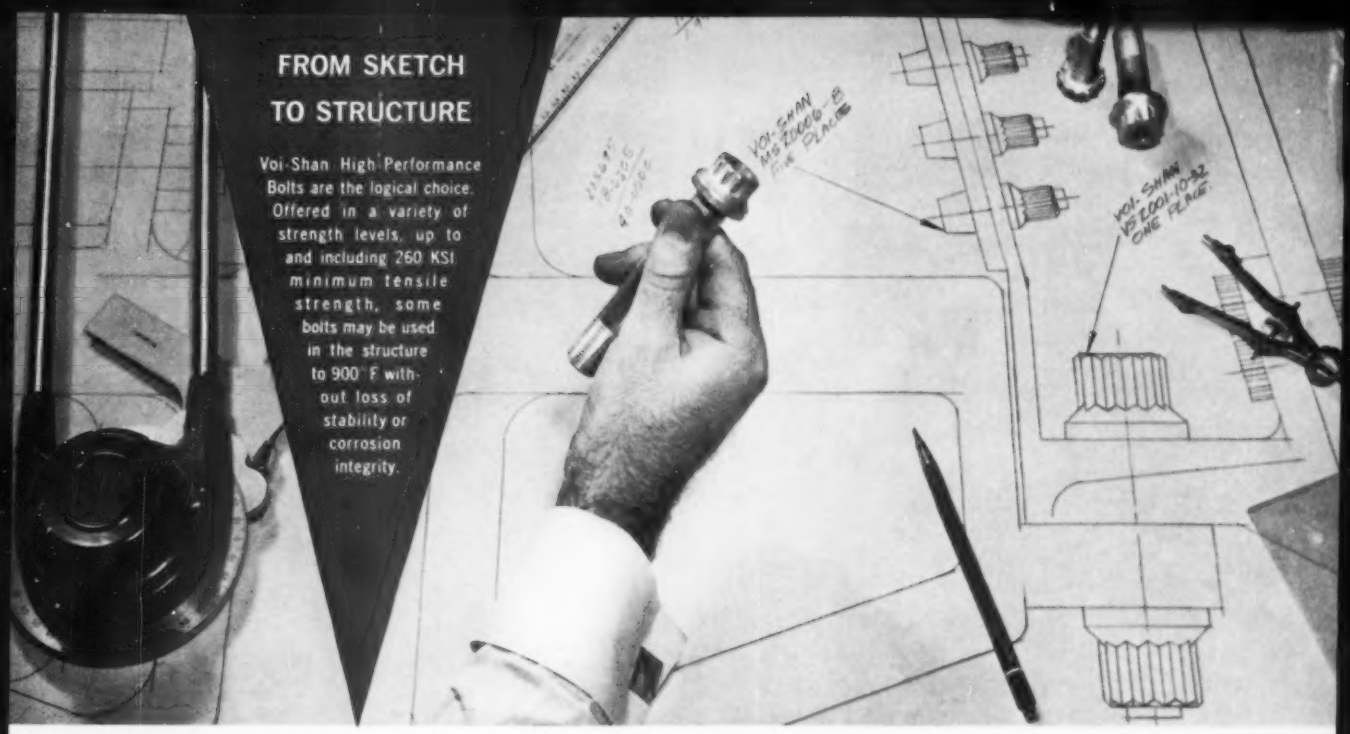
September 26, 1960

Adaptive Filter Detects Signals Buried in Noise



Short SC.1 VTOL at Farnborough

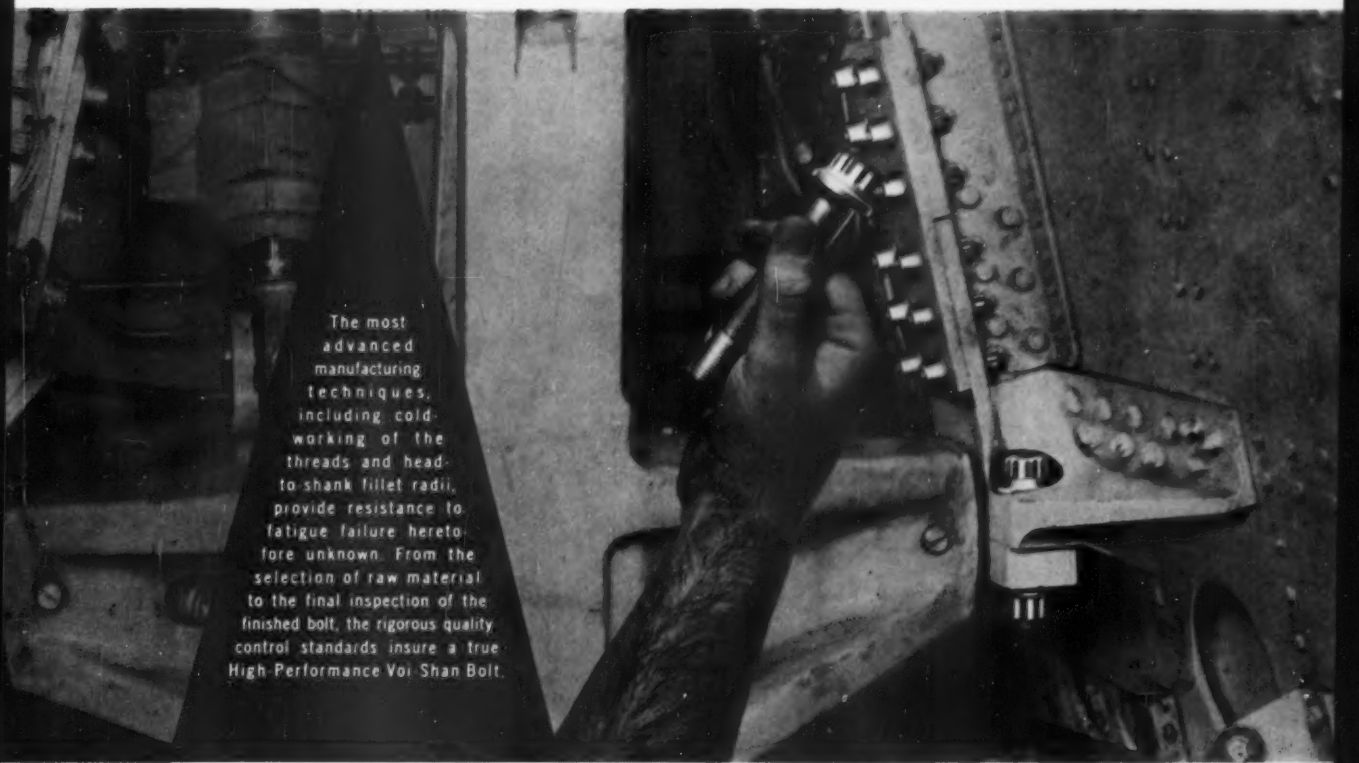
Piasecki Tests Ring-Wing VTOL Concept



FROM SKETCH TO STRUCTURE

Voi-Shan High-Performance Bolts are the logical choice. Offered in a variety of strength levels, up to and including 260 KSI minimum tensile strength, some bolts may be used in the structure to 900° F without loss of stability or corrosion integrity.

VOI-SHAN HIGH-PERFORMANCE BOLTS

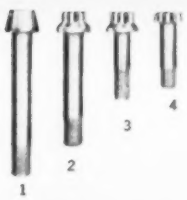


The most advanced manufacturing techniques, including cold-working of the threads and head-to-shank fillet radii, provide resistance to fatigue failure heretofore unknown. From the selection of raw material to the final inspection of the finished bolt, the rigorous quality control standards insure a true High-Performance Voi-Shan Bolt.

VOI-SHAN MANUFACTURING COMPANY

a division of Voi-Shan Industries, Inc.

8463 Higuera Street, Culver City, Calif.



Boeing 707 structure photo, courtesy American Airlines

1. Internal Wrenching Tension Bolt 160 KSI
2. External Wrenching Tension Bolt 180 KSI and 220 KSI
3. External Wrenching Tension Bolt 220 KSI and 260 KSI
4. External Wrenching Shear Bolt 220 KSI and 260 KSI

GOODYEAR PRESENTS CREDENTIALS FOR ANOTHER CAPABILITY

Here's a brand of inflation that's easy to take—Goodyear's inflatable structures that can take to the air in folded form, blossom out on-site into tough, lightweight shelters, radomes, fuel farms.

Shown above are a few recent developments in rubberized fabrics by Goodyear:

(A) **Fuel Farm** of PILLOW Tanks – these huge containers can be set up, filled and pumping in minutes. Drained, they roll up like rugs for compact storage and transport. Capacities to 50,000 gallons or more.

(B) **"Soft-Top" Radomes** by Goodyear provide all-weather protection that shrugs off snow, ice, 150-mph gales. In sizes to 100 feet in diameter, Goodyear radomes offer highest transparency to radar waves. Even radar antenna is inflatable in new design above.

(C) **Personnel Shelters** of Air Mat fold into light packs, inflate in minutes. Provide comfort and protection in worst weather. Ability to hold air eliminates air-locks and need for constantly running compressor.

(D) **Mobile Command Post** features Goodyear's 9-inch Air Mat fabric—with highest strength/weight ratio known. Stored in truck side, structure unfolds and inflates to room 25-feet-square in 15 minutes.

Portable—lightweight—super-tough—flexible—these are the *product* qualities you can count on in Goodyear inflatables. But the real secret is Goodyear's design-engineering ability to fashion rubberized fabric into shapes and constructions you'd never think possible. And the odds are that our staff can fabricate the answer to *your* problem. Find out by writing on company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. U-1715, Akron 16, Ohio, or Los Angeles 54, California.

Lots of good things come from

GOODYEAR

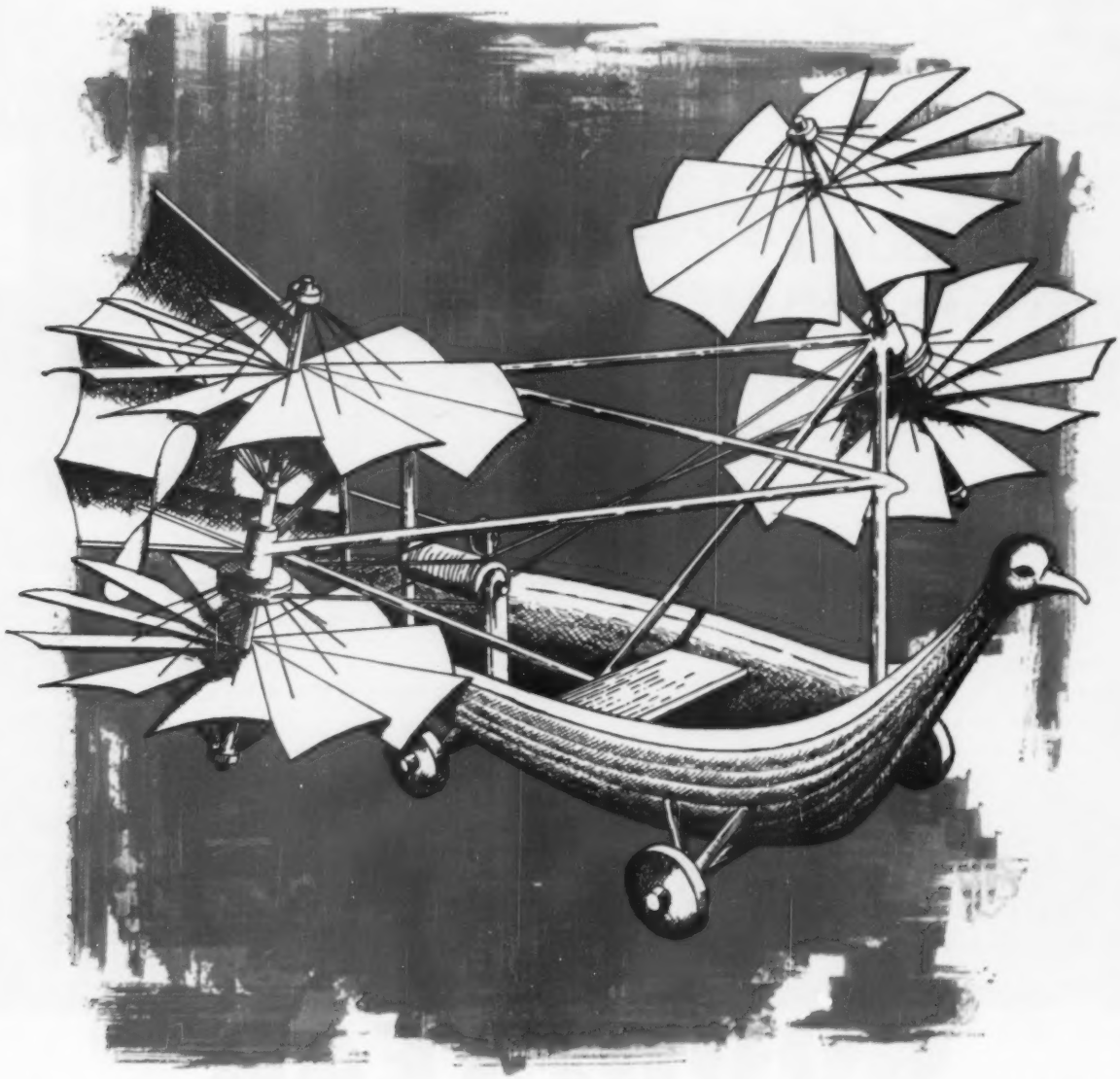
PILLOW—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

MORE AIRCRAFT LAND ON GOODYEAR TIRES, WHEELS AND BRAKES THAN ON ANY OTHER KIND

a message to men who are pioneering the future . . . Ponder for a moment the imagination behind Clayley's VERTOL craft of 1842, then marvel at where the Industry might be had this pioneer had today's production resources! ■ Because Ex-Cell-O is in business to help relieve you of many development and manufacturing details that can hamper your creativity, in this condensed list of capabilities you may find a means of getting your project off the ground sooner than scheduled: ■ Fuel controls and injection systems; linear and rotary actuators for GSE and airborne applications; air bearing devices; inertial guidance systems; servomechanisms; data processing memory drums; nuclear powerplant components; hardened and ground precision production parts. ■ Our Representative nearest you will gladly elaborate on Ex-Cell-O's products and services.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN 60-12
Aircraft & Missile Division

Artist's conception of Sir George Clayley's mid-19th Century helicopter shows contra-rotating multiple rotors and pusher props. Design lacked a practical engine and power train.



MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES: BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO., SMITH BEARING CO. ■ EX-CELL-O FOR PRECISION XLO

AVIATION CALENDAR

Oct. 3-5—Sixth National Communications Symposium, IRE, Utica, N. Y.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Oct. 4—13th Annual New York State Aviation Development and Operation Conference, Hotel Onondaga, Syracuse, N. Y.

Oct. 4-6—Sixth Conference on Radio Interference Reduction, Chicago, Ill. Sponsors: Armour Research Foundation; U. S. Army; U. S. Navy; USAF; IRE.

Oct. 5-7—Briefing Session on Opportunities in Space-Age Technology, American Management Assn., Hotel Astor, New York, N. Y.

Oct. 6-8—Annual Convention, Airmail Pioneers, El Cortez Hotel, San Diego, Calif.

Oct. 6-8—Society of Experimental Test Pilots Symposium on "Omni-sonic Flight," Ambassador Hotel, Los Angeles, Calif. Fourth Annual Awards Banquet, Oct. 8.

Oct. 6-9—Annual Meeting, National Pilots Assn., Western Hills Lodge, Wagoner, Okla.

Oct. 8—Third Annual National Aero Club Football Fly-In, Michigan vs. Duke, Ann Arbor, Mich.

Oct. 10-12—1960 National Electronics Conference and Exhibition, Hotel Sherman, Chicago, Ill.

Oct. 10-14—Society of Automotive En-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

September 26, 1960

Vol. 73, No. 13

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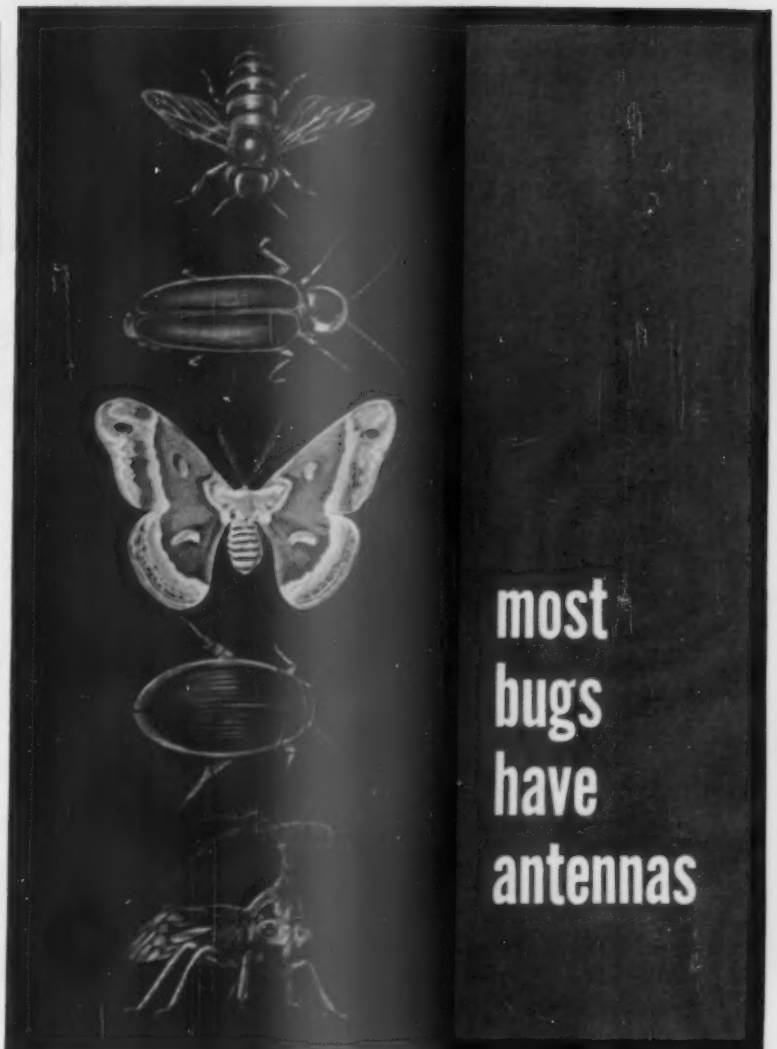

. . . but the reverse of the above statement is being challenged successfully at Dorne & Margolin, Inc.

It has taken insects thousands of years to evolve countless variations of antennas to suit environmental conditions and adapt them to perform specific functions perfectly. Dorne & Margolin engineers have less time at their disposal, yet they achieve similarly satisfactory end results.

And the insect world has nothing on Dorne & Margolin when it comes to all-out organization to get the job done. Meticulous as bees, determined as ants, more curious than moths . . . that's the approach to every problem in components or systems . . . aircraft or missiles, practiced by D & M engineers.

The results have been products in which we can confidently take pride . . . just ask our customers*. By the way, our engineers still have a healthy and creative curiousity about antenna problems. If there's one plaguing you, no matter how large . . . or small, drop us a line.

*A customer list is included in our Antenna Catalog. Write for your copy today.

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If you're an engineer whose creative curiousity is matched by a desire for many organizational benefits, including stock participation, contact R. E. Anderson, Chief Engineer.

This is the SWAMI MOTION DETECTOR, a compact practical detection device for Perimeter Protection, Plant and Area Security.

NEW "POCKET RADAR"

Sensitive, dependable, inexpensive, unitized construction (it's small enough to fit into an attache case). *Where can you use it?*

The SWAMI MOTION DETECTOR is a new low-cost intrusion detector system that saturates a secured area with ultra high radio frequency energy sensitive to the slightest motion or displacement of an intruder. It is fail safe, simple to install, easily operated. And, it is virtually impossible to confound with counter-measures: any tampering will cause an alarm.

Effective Range: From inches to hundreds of feet, with a single unit. Surveillance can be maintained over a full acre, economically.

Flexibility: It can function as an omnidirectional or directional system, and can determine relative or absolute speeds of moving targets.

Durability: The sensor unit of the SWAMI MOTION DETECTOR is shock-resistant, and its service life compares favorably with that of conventional vacuum-tube detection devices.

Power Supply: Standard 115-volt outlet current or any battery-supply DC. *Write for free brochure to:*

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AVIATION CALENDAR

(*Continued from page 5*)

gineers National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Calif.

Oct. 10-14—82nd General Conference, National Guard Assn. of the U. S., Hawaiian Village Hotel, Honolulu, Hawaii.

Oct. 11-12—Fall Meeting, Institute of Printed Circuits, Sheraton Towers Hotel, Chicago, Ill.

Oct. 12-14—Third AFOSR Astronautics Symposium, Ambassador Hotel, Los Angeles, Calif. Sponsors: Air Force Office of Scientific Research; Society of Automotive Engineers. (Open Meeting.)

Oct. 12-14—Seventh National Symposium, American Vacuum Society, Cleveland-Sheraton Hotel, Cleveland, Ohio.

Oct. 14-15—Symposium on High-Speed Processing, Society of Photographic Scientists & Engineers, Washington, D. C.

Oct. 14-15—15th Midwest Conference, American Society for Quality Control, Broadview Hotel, Wichita, Kan.

Oct. 15-16—Fort Rucker Fly-In. For information: Commanding Officer, 2nd Battle Group, 31st Infantry, Fort Rucker, Ala.

Oct. 16-19—Mid-Year Conference, Airport Operators Council, San Francisco.

Oct. 17-18—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 17-21—National Safety Council's 48th National Safety Congress, Conrad Hilton Hotel, Chicago, Ill.

Oct. 19-21—Annual Convention, Southeastern Airport Managers' Assn., Far Horizons Motel, Sarasota-Bradenton, Fla.

Oct. 19-21—Symposium on Space Navigation, Institute of Radio Engineers, Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-21—Annual Meeting, Society for Experimental Stress Analysis, Hotel Claremont, Berkeley, Calif.

Oct. 20-21—National Symposium on Hypervelocity Techniques, Institute of the Aeronautical Sciences, Shirley-Savoy Hotel, Denver, Colo.

Oct. 24-26—Medical and Biological Aspects of the Energies of Space, Unclassified Symposium, Granada Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine. Arranged by Southwest Research Institute.

Oct. 24-26—Seventh East Coast Conference on Aeronautical and Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 25-27—11th National Conference on Standards, Sheraton-Atlantic Hotel, N.Y.C.

Oct. 27-28—1960 Annual Electron Devices Meeting, Institute of Radio Engineers, Hotel Shoreham, Washington, D. C.

Oct. 27-29—1960 Industry Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 1-2—Fall Meeting, Radio Technical Commission for Aeronautics, Sheraton-Park Hotel, Washington, D. C.

Nov. 2-4—Tenth Aircraft Hydraulics Conference, Pick-Fort Shelby Hotel, Detroit, Mich., Sponsor: Vickers, Inc., division of Sperry Rand Corp. (Invitational.)

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Eighteen-foot diameter radome of WSR-57 Stormfinder radar. System operates at S band, has 250-mile range.

Dr. F. W. Reichelderfer, chief of the Weather Bureau, calls this "the best weather radar in the world."*

Raytheon STORMFINDER shows a composite picture of the entire weather front over a 200,000 square mile area. The "weather eye" pinpoints and tracks storms 250 miles away, distinguishes hail, rain, and snow, probes the heart of a hurricane. It is ground-based . . . and designed, developed and produced specifically for weather detection and analysis.

EQUIPMENT CHARACTERISTICS

Iso-echo feature. Sensitivity Time Control of 20 db between 10-100 miles. Triple display indicator unit: (1) 7" RHI (range height indicator), (2) 12" PPI (plan-position indicator), (3) 7" A/R Scope for storm intensity measurement.

Power output	500 KW	
Frequency	2.7 — 2.9 kmc	
Beamwidth	2.2°	
Elevation	−10° to +45°	@ 6 scans/min
Azimuth	360°	@ 1-4 scans/min

*from testimony before a House Appropriations subcommittee, January 18, 1960.

RAYTHEON EQUIPMENT DIVISION

Excellence in Electronics

For Raytheon Weather Radar Brochure, *Write: Director of Marketing, Equipment Division, Dept. C2, Raytheon Company, West Newton, Mass.*

ANTI-FRICTION BEARINGS:

When the countdown is on . . . the success of each missile depends completely on split-second operation of all moving parts: aboard the "bird" or among the actuators, erectors, drives, and support equipment hinges — friction must be conquered.

And in the entire missile and defense industry, there is no more sweeping capability in *friction fighting* than Torrington's.

On these pages, you can spot some of the vital missile support missions made to order for TORRINGTON BEARINGS. Here's your key to a few: missile hold-down clamps and actuators 1; missile erectors 2; missile handling equipment 3.

In missile equipment of tomorrow, suggested on the facing page, Torrington bearings will help gigantic gantry cranes to move into position around the giant rockets now under development (shown: Saturn spacecraft booster and gantry, number 4.)

Missile trains are due to start roaming the Nation's railways in 1965. Chances are that trains, missile erectors and actuators 'raising the roof' of the missile wagons will all have this in common: bearings by Torrington (number 5).

Perhaps even the amazing ground effect vehicles which may act as missile carriers during the late sixties will spin their fans and lift their warloads into firing position assisted by Torrington anti-friction bearings.

Returning to the present, look for these other important TORRINGTON BEARINGS applications in missile support equipment: bearings for large

TURNING POINT IN MISSILE PROGRESS

radar tracking equipment and radar azimuth systems (the largest radio telescope in the world — the Navy's 600-ft. dish now being built in West Virginia — will turn to the stars on specially designed and built Torrington bearings). Blast doors on Titan and Atlas silos will swing on Torrington bearings — and deep in the hardened missile sites, large Torrington bearings equip the crib suspension cylinders, which protect the missile and its launcher from the shock of hostile nuclear weapons. Hydraulic cylinders, drives, and cable sheaves operate freely thanks to Torrington.

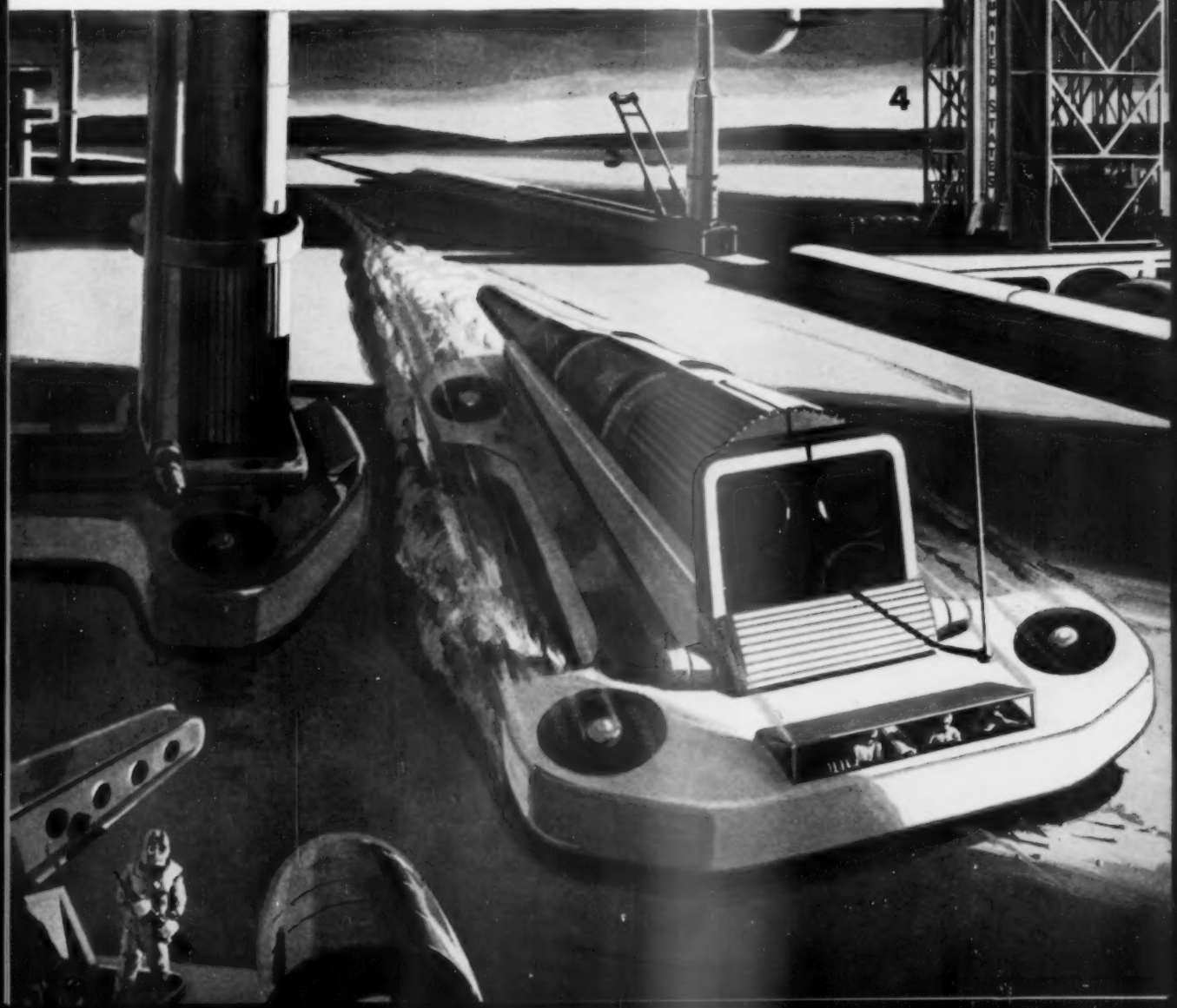
Aboard the missiles themselves, other Torrington products do more than their share for performance and reliability. Remarkably strong for their size and weight, Torrington needle bearings take the friction out of missile actuators and control surface supports.

Current Torrington research and development programs have brought about needle and roller bearings ideal for spacecraft control surfaces, and missile hot spots — rocket nozzles, combustion chambers, ramjets and afterburners. Efficient operation at 1200°F and beyond are about to be conquered.

In helping missiles move about more easily, launch successfully, fly more reliably and accurately, Torrington bearings are playing a pioneering role in the Space Age.

send for your special report on missile and space age bearings **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY Torrington, Conn. • South Bend 21, Indiana



CLIMATE CONTROL:

Missiles and missile support equipment are vulnerable to heat and moisture — must be protected from the internal environment which they themselves bring about.

For instance, moist air creeping into a radar waveguide can condense and produce disastrous short-circuits and arc-overs in high voltage locations; banks of electronic tubes generate so much heat that tube life and system reliability drop to intolerable levels. Then, too, sensitive electronic systems are called upon to operate in the midst of widely fluctuating ambient temperatures — but must maintain a narrow internal temperature within in order to perform as planned.

Eastern Industries makes it its business to solve this type of problem for you — to guard airborne and earthbound missile electronics from the twin threats of moisture and temperature.

Eastern *dehydration pressurization packs* protect the wave guide of the Nike Hercules radar shown below by supplying a flow of dry air under pressure; leaks in the wave guide tunnel let gas inside leak *out* — ambient air *stays* out. Aboard a mobile ground-to-air missile radar, an Eastern Industries pressurization-dehydration pack features an automatic reactivating dehydrator with a single cartridge — and far fewer components than conventional two-cartridge pack.

Eastern *liquid cooling units* keep electronic systems on the job — when they generate internal heat at a rate too high for convection cooling, forced air circulation or heat sinks. If you have an electronic tube cooling problem ranging from 50 to 50,000 watts dissipation rates, check with Eastern Industries — the acknowledged leader in this specialized field. In avionics cooling components, Eastern Industries know-how is just as important as in complete systems. For instance, Eastern has just developed a constant mass fan effective over a wide altitude range. The use of a constant torque magnetic coupling device permits selection of a smaller drive motor than ordinarily employed. Small, light weight aircraft pumps form the heart of every Eastern electronic cooling pack. Design with these high-speed gear pumps in mind — hundreds of these hydraulic units are available virtually off the shelf — or can be adapted for you.

Eastern *refrigeration cooling units* safeguard elec-

FAIR WEATHER FOR *MISSILE MISSIONS*

tronic systems at a preselected temperature level — regardless of abrupt changes of ambient temperatures. These units can be furnished in the range of 100 to 6000 watts — measure up to the most rigorous military requirements.

Eastern Industries may also have the answer to your requirements in *servo valves, actuators, amplifiers* and *complete servo systems* — for both missile and missile support applications. Eastern offers you single system responsibility for complete servo systems and components. If you're looking for fast response, reliability, flexibility and light weight, write for the new Bulletin on Electro-Hydraulics — Eastern's review of servos and servo systems.

For both pneumatic and fluid systems, Eastern *quick-disconnect couplings* are the smallest, lightest available for high-pressure conditions. Now available — a special automatic quick-disconnect coupling for remote actuation. This new assembly can be obtained in the same capacity range, size, and high quality as the standard miniature couplings. Write for Bulletin EQD-200.

Light weight *turbine fuel control systems* also come within the Eastern capability. Eastern has designed and built a complete turbine fuel and lube control system weighing only two pounds. It contains: fuel pump pressure control valve, pressure regulating valve, oil pump filter and pressure valve, and starting fuel bypass valve.

Brand new concepts in *hydraulic power packs* are old hat with Eastern. Hydraulic systems with self-contained power sources trade on the use of miniature gear pumps driven to 24,000 rpm for size and weight reduction down to the irreducible minimum.

Other Eastern capabilities in missile support equipment cover high-speed gear pumps, centrifugal pumps, hydraulic power units, quick-disconnect couplings, and servo systems. For a full appraisal of Eastern products and potential in missiles and manned aircraft, write for Bulletin 370A.

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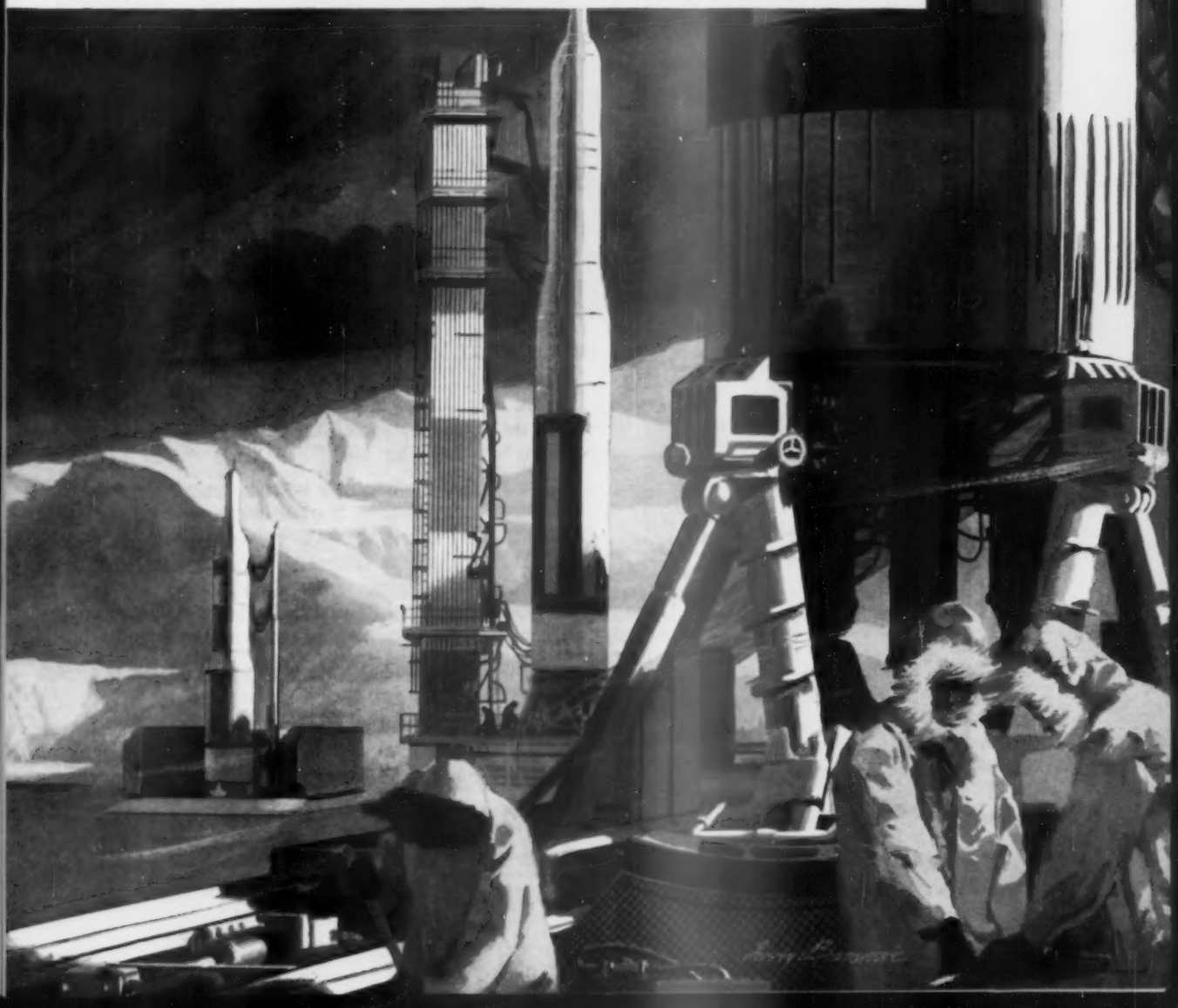

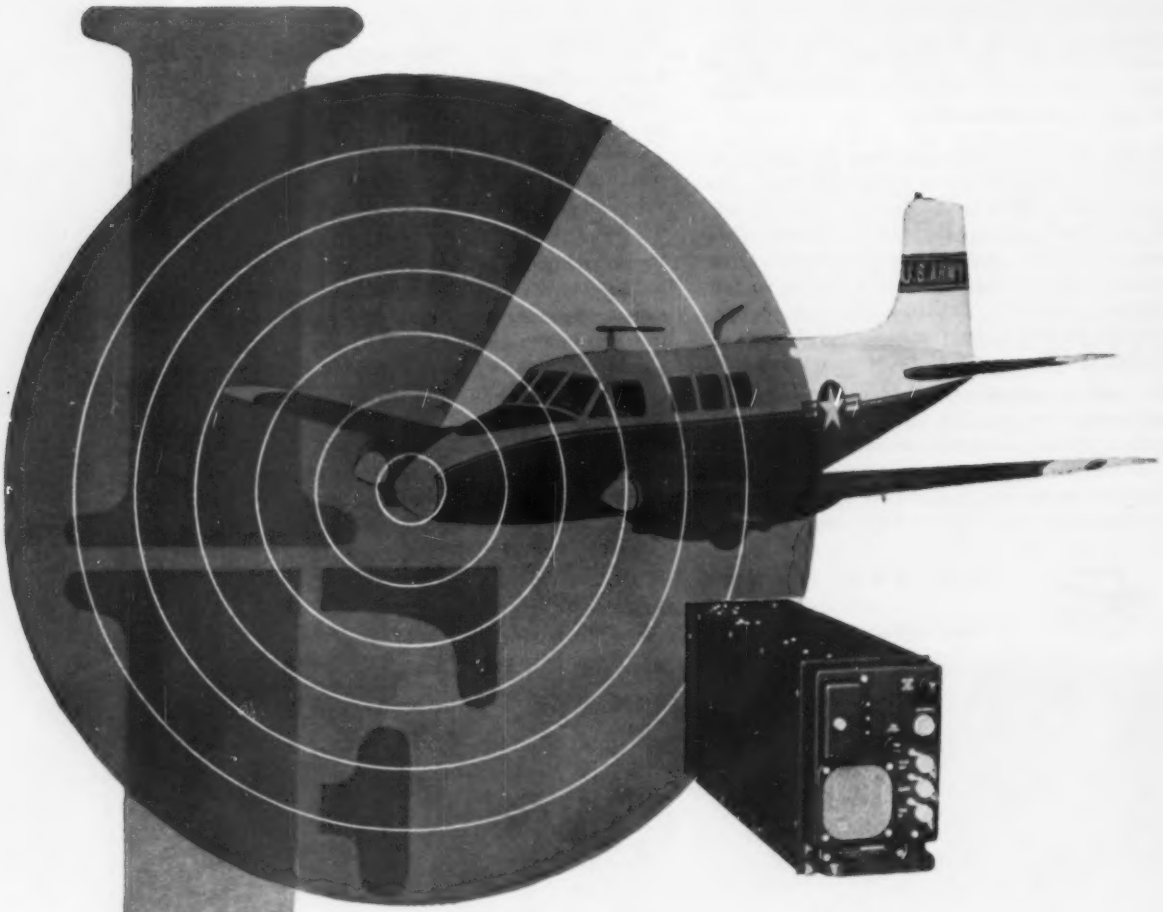

IFF

Any time... any place... any mission

wilcox-developed AN/APX-44 TRANSPONDER

safeguards Army aircraft

Now being installed in U. S. Army aircraft, the AN/APX-44, designed and produced by Wilcox Electric, provides reliable IFF, SIF and ATC functions during any mission.

The AN/APX-44 automatically transmits specially coded identification pulses when subjected to radar interrogation. These replies identify the Army aircraft as friendly and provide ground and airborne interrogators with position data, aircraft description and other helpful information. This transponder also reinforces primary radar replies to permit reliable tracking of the aircraft at extended ranges, despite conditions of inclement weather, ground clutter and dense traffic.

Wilcox has produced these airborne units in quantity and on schedule for Army installation.

The AN/APX-44 features minimum size and weight, modular construction, a crystal-controlled receiver and cavity-tuned transmitter. It is indicative of the electronic systems capabilities and experience of Wilcox.

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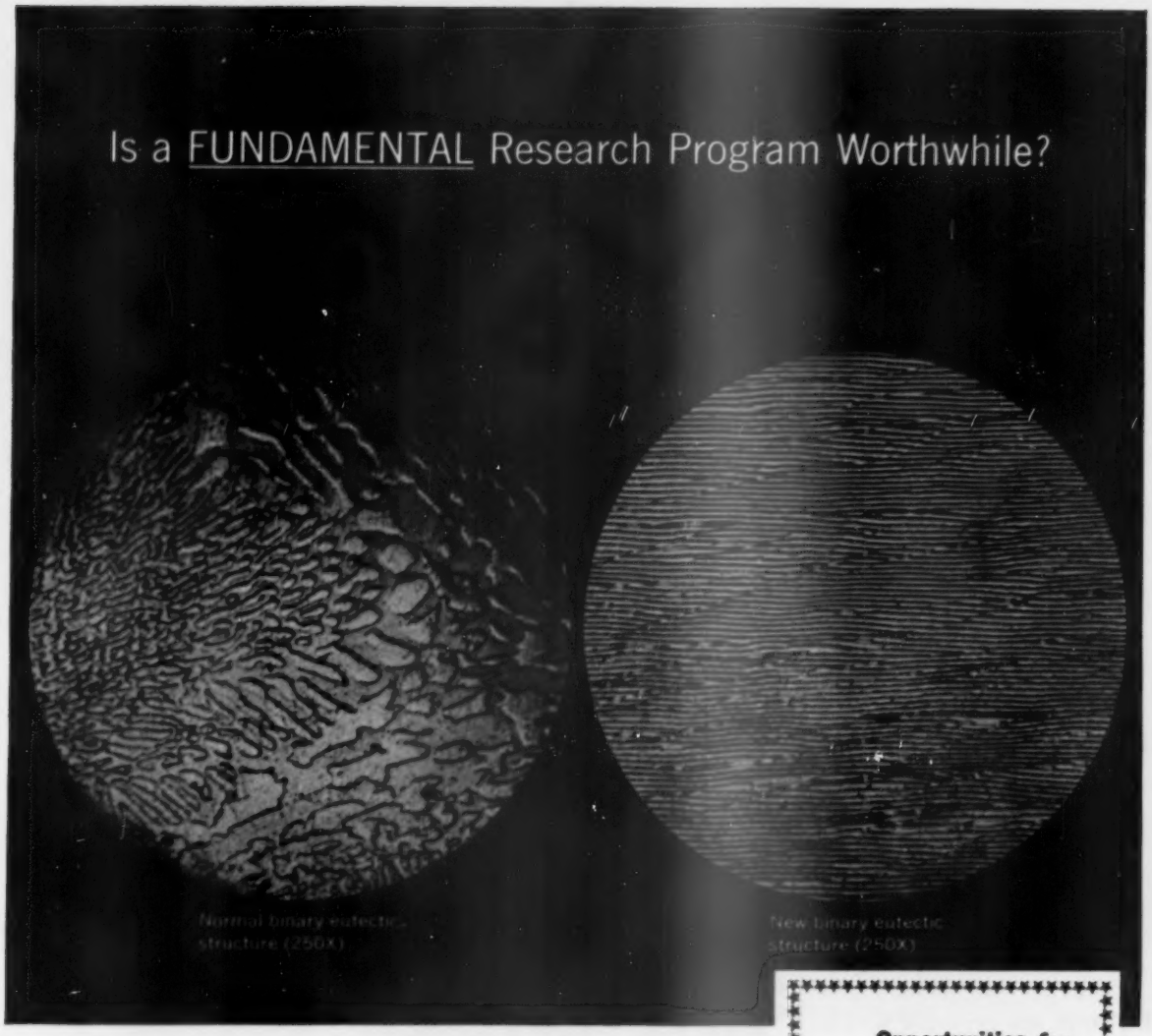
Is a FUNDAMENTAL Research Program Worthwhile?



We, at the Research Laboratories, are convinced that it is worthwhile. For example, one of the fundamental scientific programs being undertaken is a study of the mechanism of solidification of polyphase alloys.

This study is still in its early stages. However, we now have a better understanding of the solidification process. And we have demonstrated that the microstructure of certain eutectics can be significantly altered by controlled solidification. The contrast is illustrated above.

It is possible that these binary alloys with preferred orientation may have unusual physical and mechanical properties.

Perhaps you are interested in corporate-sponsored studies into the fundamental nature of matter. If so, we can offer a research environment that seems to stimulate scientists to extra achievement. It may be due to the way we encourage an internal cross-fertilization of ideas; or because of a unique complex of complementary services that free the scientist from routine analysis and experimental chores.

Opportunities for scientists in the physics of solids, liquids, gases, and plasmas. Current studies range from the fundamental properties of matter to the application of scientific knowledge to promising new products.

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For more specific information, please write to Mr. W. D. Walsh, at the Research Laboratories.

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Quaker Thermoid

THE ONLY JET STARTER HOSE GUARANTEED FOR 4500 STARTS

UNIQUE CONSTRUCTION OUTLASTS AND OUTPERFORMS ALL OTHERS

Fittings are provided to fit standard connections on all aircraft and starter trucks. They are easily removed and reassembled in field, yet they safely withstand duct pressures far in excess of burst point.

Duct liner consists of seamless, extruded Silicone rubber for resistance to high heat, up to 500°F, and flexibility at temperatures as low as 65°F.

Scuffer jacket protects hose from abrasion. Loosely fitted sleeve of open mesh Dacron is resistant to mildew, fungus, extreme heat or cold. Spiral scuffer strip of natural rubber is bonded to sleeve. Easily replaceable.

Duct reinforcement is a bonded layer of interwoven Dacron for strength, dimensional stability and resistance to mildew, fungus and extreme temperatures.

Jet Starter Hose, pioneered and developed by Thermoid Division, is the only hose *guaranteed* to perform satisfactorily for a full year or 4500 starts . . . is the *only starter hose approved by the government* and is the choice of major jet operating airlines the world around. Exhaustive use has demonstrated that Thermoid-Quaker Jet Starter Hose outperforms other hose by more than three to one.

For more information on this outstanding jet starter hose see your Thermoid Division distributor or write *Thermoid Division, H. K. Porter Company, Inc., 200 Whitehead Road, Trenton 6, N.J.*

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Hiller 12 E sets aviation record, lands and picks up payload at 18,000 ft.
12 E, first light copter to erect entire powerline; 40' poles, el. 5,000 ft.
34,500 lbs. of machinery to exploration mine in 8 hrs. mountain flying.
Microwave station on 4,000' ridge; all 8 tons material; 2 days flying.

You are invited to write for full details.

THE ARMY GROWS 'EM TOUGH

How the Hiller 12 E Became First Choice of Commercial Operators

From the day it went into commercial service, the Hiller 12 E had a head start. It had an Army-proved H-23D airframe and an Army-proved H-23D drive system that hadn't begun to exploit its full strength.

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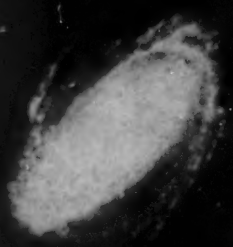
Space power requirements—in not too many years—will be measured not in watts or kilowatts, but in megawatts. This need presents formidable technical problems.

We are making progress toward their solution.

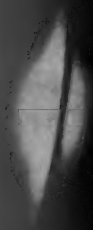
Westinghouse

Space



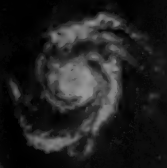
Spiral nebula in Ursa Major

Moon, age 14 days



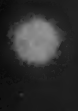
Spiral nebula in Virgo

Spiral nebula in Andromeda

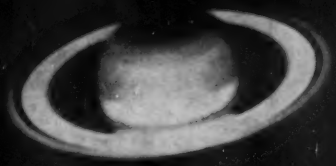


Spiral nebulae in Canes Venatici

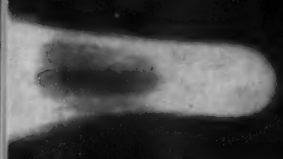
Filamentary nebula in Cygnus



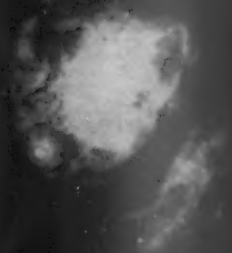
Globular star cluster in Canes Venatici



Saturn and ring system



Head of Halley's Comet



Nebula in Sagittarius

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September 26, 1960

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COVER: Short SC.1 VTOL research vehicle hovers on the lift of four Rolls-Royce RB.108 engines before making transition to level flight at 21st Society of British Aircraft Constructors' Flying Display and Exhibition at Farnborough (AW Sept. 12, p. 26). SC.1 was designed to prove out one concept of vertical rising aircraft, and is a design compromise between known configuration and possible future layout of aircraft using jet lift. Propulsion comes from thrust of fifth RB.108 engine installed in conventional location. For other pictures, see pp. 64-65.

PICTURE CREDITS

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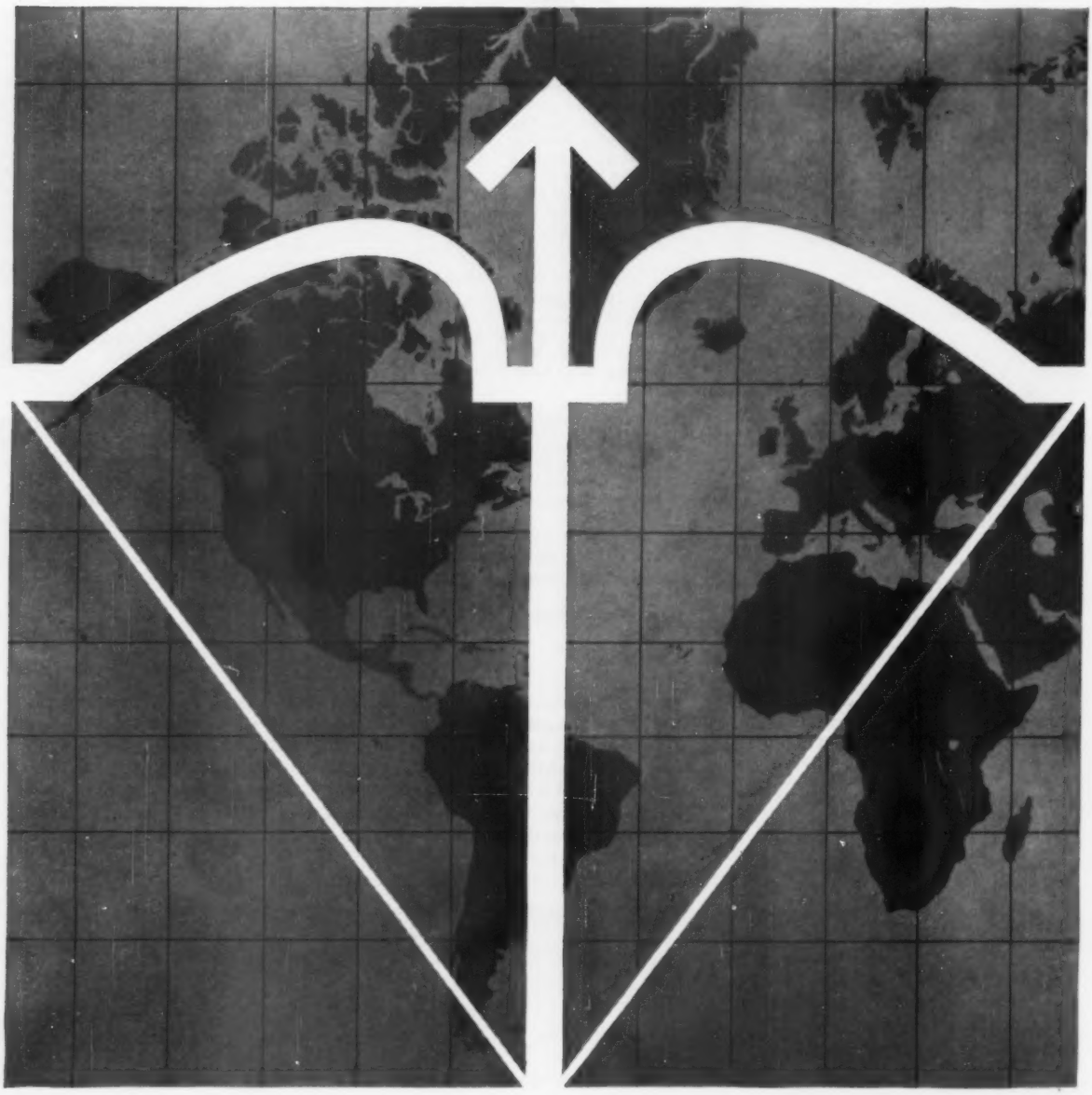

EDITORIAL

Welcome to Denmark

This is an unabashed paean of pure praise for an enterprising country that has developed the art of making the American tourist feel at home away from home and has taken decisive steps to break the hotel bottleneck that is now the real limit on transatlantic air travel. The American tourist trade to Europe has grown into a multi-million dollar annual affair that moves more foreign exchange into European coffers than any other single item of trade. With the advent of the Boeing and Douglas jet transport fleets on the transatlantic run this year the capacity for whisking people across the Atlantic in a fraction of a day has grown enormously. Yet facilities to accommodate tourists in Europe have not kept pace. The traditional gateways to Europe of London and Paris have become horrendous hotel bottlenecks with few signs of any significant increase in hotel capacity on the horizon in either capital.

Pleasant Contrast

Thus it is refreshing for an American to visit Denmark and see what the enterprising Danes have done to siphon more of the transatlantic tourist market into the northern gateway of Europe. You are aware of the difference immediately on arrival at Kastrup's new ultra-modern air terminal building. Here the Danish immigration officers stamp green American passports with "Welcome to Denmark" beneath the official imprints and present each American with a message of welcome from the Danish prime minister and a ceramic Viking ship button. From then on the Danes exercise ingenuity in trying to provide every means for the American visitors to enjoy and understand Denmark and leave a reasonable portion of their tourist budget in Danish coffers. All of this is done with an air of pleasant efficiency that is a welcome contrast to the rapacious innkeepers of musty Parisian hotels and the bored indifference of the British hostelries.

Five new modern glass and steel hotels have sprung up among the verdigris-coated copper towers of Copenhagen's skyline—more modern hotels than have been built in postwar London and Paris combined. They include the superb 21-story Scandinavian Airlines System hotel that rises next to the main downtown air terminal. To ensure that no tourist goes without a bed in Copenhagen the Danish tourist bureau maintains a special housing office that copes with any emergency even to finding rooms in Danish homes when the hotels overflow. Special dormitories are opened to foreign students during the summer rush. The Danes even provide large-scale baby-sitting facilities where visiting children are organized into groups for activities suited to their age levels while their parents can pursue their own interests.

Tourist Attractions

In the heart of Copenhagen there is a continuous demonstration of Danish cuisine to quickly acquaint visitors with the delights of local food. Close by is a large exhibition of the work of Danish craftsmen in silver, ceramics, furniture and textiles with facilities for ordering and shipping and for handling all customs problems. You will hardly be in Copenhagen long before you are lured to the famous Carlsberg and Turborg breweries to tour their facilities and sample their products. If the pace gets too rigorous, as it often does, there is a tremendous hot bath facility on the scale of Tokyo Onzen, where expert masseurs put you back in shape to continue the fun. When SAS has a transpolar or transatlantic schedule that gets into Kastrup in the early morning hours it alerts the bath house and bundles all its weary transit passengers through the steam, dry heat and icy pool, and gives them some of the famous Danish open-face sandwiches and beer before sending them on to their ultimate destinations.

It is difficult to fully convey the friendly atmosphere of Denmark toward American tourists because so much of it lies not in the formal evidence outlined above but in the routine dealings with its people where the unexpected always turns out to be pleasant. All of the delegates to the 16th annual general meeting of IATA held in Copenhagen earlier this month as well as the thousands of American tourists who passed through this gateway to Europe last summer will heartily endorse these sentiments. Other countries with more resources and a larger stake in the transatlantic tourist trade would do well to follow Denmark's fine example in providing the proper facilities to expand this market for the future.

—Robert Hotz

D DAY, THE LACK OF RECONNAISSANCE AND A FAULTY COMMAND DECISION

At 10:15 p.m., June 5, 1944, Lieutenant Colonel Meyer, counter-intelligence chief of the Fifteenth German Army burst into his commander's dining room; interrupting a relaxed game of cards. He held a message intercepted from Allied Headquarters, a message the German General Staff knew meant Allied invasion within 48 hours! But the card game placidly continued. Reason: no reconnaissance verification. Though a 5,000 ship, 20 mile wide invasion fleet clogged the English Channel, not a single Luftwaffe plane reported this progress. And so Field Marshal Rommel, commander of German forces in the area, was not notified until after H hour and remained on leave in Germany. Later, urgent pleas for panzer divisions in reserve near Paris were rejected by higher authority in Germany who thought the Normandy invasion was merely a diversion.

Why such confusion, particularly when Rommel's military tactics included the study of Confederate generals with their dependence on the swift reconnaissance "eyes" of J.E.B. Stuart's cavalry? Answer: unlike the reconnaissance-wise Confederates, Rommel's "eyes" were obsolete for their day . . . fighter aircraft, modified for the important reconnaissance mission. Result: lack of reconnaissance . . . D-Day success for the Allies.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

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WHO'S WHERE

In the Front Office

Dr. Hermann H. Kurzweg, assistant director for aerodynamics and flight mechanics, NASA's Office of Advanced Research Programs, succeeding **Milton B. Ames, Jr.**, now deputy to the Advanced Research Programs Director.

John B. Montgomery, vice president, General Electric Co., New York, N. Y. Mr. Montgomery is general manager of GE's Flight Propulsion Division, Evendale, Ohio.

William Lush, president, Ideal-Aerosmith, Inc., Cheyenne, Wyo., a division of Royal Industries, Inc.

Patrick S. Parker, a director, The Parker-Hannifin Corp., Cleveland, Ohio. Mr. Parker is division manager of the company's Parker Aircraft Division, Los Angeles, Calif.

Lt. Gen. C. S. Irvine (USAF, ret.), a director, Idaho Maryland Industries, Inc., Glendale, Calif.

John H. Carter, president, Information Technology Laboratories, formerly named the Boston (Mass.) Division of Itek Corp., Waltham, Mass.

F. Kenneth McKnight, West Coast manager for Rader & Associates, Miami, Fla., and vice president in charge of military sales for Airtronics International, Fort Lauderdale, Fla., with headquarters in Beverly Hills, Calif.

Myron D. Lockwood, vice president, Sperry Gyroscope Co., Great Neck, N. Y., a division of Sperry Rand Corp. Also: **Thomas W. Melia**, division manager.

Mark W. Bullock, vice president-engineering, Continental Electronics Manufacturing Co., Dallas, Tex., a subsidiary of Ling-Temco Electronics, Inc.

Autonetics, a division of North American Aviation, Inc., Downey, Calif., has appointed the following as vice presidents: **Dr. Dean O. Bowman**, responsible for preparing and maintaining integrated over-all long range planning; **Robert T. Jones**, in charge of organizing and directing operations outside continental U.S.; **Norman P. Hays**, coordinator of military and civilian requirements-Eastern U.S.; **Rolf D. Cape**, head of the European office, Geneva, Switzerland.

Jack H. Zillman, vice president-Data Processing Division, Consolidated Electrodynamics Corp., Pasadena, Calif., a subsidiary of Bell & Howell Co.

John Harlan Kerr, vice president and general counsel, Thompson Ramo Wooldridge, Inc., Cleveland, Ohio, and **Eugene E. Ford**, assistant general counsel, and **Paul W. Schuette**, secretary. Also named company vice presidents: **George W. Fenimore**, general manager, TRW International Division; **Warren B. Hayes**, general manager, TRW Electronic Components Group; **John H. Shaffer**, director of sales, TRW Tapco Group.

John Buchholz, vice president, Amphenol Connector Division, Amphenol-Borg Electronics Corp., Broadview, Ill.

David J. Belcher, assistant to the vice president-in charge of West Coast operations, Townsend Co., Santa Ana, Calif.

(Continued on page 132)

INDUSTRY OBSERVER

► Three Russian technicians are training at Sikorsky and three at Vertol in preparation for delivery to Russia of two Sikorsky S-58s and a Vertol Model 44 helicopter. Russians expect to receive all three within the next several weeks (AW Sept. 19, p. 23 and Nov. 23, 1959, p. 25).

► **USAF is considering putting a portion of the $100 million voted by Congress for interceptors into two-place, tandem Convair F-106Bs so they can be used for crew training for the North American B-70 bomber. Lockheed F-104B and Republic F-105 also have been proposed for this training, but F-106B is a delta-wing aircraft with characteristics more similar to the B-70. Crews would fly with Air Defense Command, shift to Strategic Air Command later along with their aircraft.**

► Two systems more sophisticated than the Tattletale rocket-borne radio (AW Sept. 5, p. 39) are being considered by USAF for communicating with aircraft and bases during an enemy-caused radio blackout. They are "rocket emergency communications system," using a rocket-launched repeater for a ground-to-air-to-ground link; and an emergency positive control communications system involving an aircraft-carried recorded message for large area coverage. Wright Air Development Division is expected to have the responsibility if either system should be adopted.

► **Rollout of first Vertol 107 Model II is scheduled for early October. Conversion of the Army-bailed YHC-1As, which were powered by two General Electric T58-6s rated at 850 shp. each, to the advanced configuration includes installation of two GE CT58-100 gas turbines rated at 1,050 shp. each. Complete dynamic system of Model II is rated to 2,500 shp. to take the CT58-110, rated at 1,250 shp., when that engine completes certification. First Vertol 107s delivered to New York Airways will use the certificated -100 engine.**

► Arma Division of American Bosch Arma Co. is developing highly miniaturized guidance computer for the hard-landing lunar capsule in NASA's Ranger program.

► **NATO is developing a general operational requirement for a STOL transport aimed at logistic support of VTOL fighter-bombers. Design requirements have not yet been released to industry but are believed to be based on a 20-ton payload, a cruising speed of 200 kt. and takeoff from a 500 ft. strip, clearing a 50 ft. obstacle at end of the strip.**

► Six companies will be selected, probably by Oct. 1, to participate in the unfunded Phase II study of the small, mobile Midgetman intercontinental ballistic missile (AW Sept. 19, p. 26).

► **USAF's Cambridge Research Laboratories is developing airborne seeding equipment that will enable aircraft to dispense dry ice crystals into supercooled fog or stratus clouds, producing holes through which aircraft can land at fields not equipped with avionic aids. Russians report they have developed such equipment, using basic techniques developed originally by the U.S. (AW Aug. 15, p. 23).**

► Britfsh, French and German designs appear to be major competitors for the NATO VTOL fighter competition. NATO specification require a high subsonic performance at sea level and supersonic speed above 4,000 ft. Both Bristol Siddeley BS23 and advanced versions of Rolls-Royce special lift engine series are being used as powerplants.

► **USAF Ballistic Missile Division briefed industry last week on high-altitude reconnaissance plans and procedures. BMD invited 72 companies to the conference.**

► Lockheed is proposing a VTOL version of its F-104 Starfighter for European use with two lift fan engines installed in the wings.

HOW THE SILICONES MAN HELPED AMERICA KEEP ITS DATE WITH THE JET AGE

As your jet air liner streaks aloft today, UNION CARBIDE Silicones are aboard to help. Silicones aided in its manufacture, too. The giant tires slipped easily from their original molds because of silicone mold release agents. Polyether foam seat cushions were formed under the near-ideal control of silicone surfactants. Soft, flexible oxygen masks, of oxygen- and ozone-resistant silicone rubber, fit facial contours without irritating the skin. Silicone fluids damp out vibration in vital, sensitive instruments. Silicone rubber door seals never lose resiliency even in extreme temperatures, won't harden or shrink. This constant flexibility makes it the basic material in blankets used for construction of honeycomb structural panels, also in grommets, gaskets, and O-rings. And in the flexible hoses in hot-air jet-engine starters. You'll find jet aircraft radio and radar wires insulated with electrically resistant silicone rubber. Piston plane and helicopter ignition wiring, too. Also the boots for helicopter control sticks, many other parts. This is only a smattering of what silicones have been doing for just one industry—aviation. Is your business enjoying equal benefits? We suggest you contact the UNION CARBIDE Silicones Man. Address: Silicones Division. Dept. I A-0002, Union Carbide Corporation, 270 Park Avenue, New York 17, New York.

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UNION CARBIDE SILICONES

Washington Roundup

Defense Dollar Thaw

Defense Department is steadily releasing additional money for key weapon programs. It now expects to allocate virtually all of the $39.9 billion voted by Congress for Fiscal 1961. This was a net $661 million increase over the budget proposed by the Administration.

The freeze is thawing rapidly on the $621 million withheld under the mid-August defense financial plan. This August plan released over $470 million additional for top priority programs. Now more is being released. Frozen funds have now dwindled to about $450 million, and some of this is simply money withdrawn from obsolescent programs which the Pentagon has not yet re-allocated.

Navy has $100 million to go ahead with development of its 2,500 mi. Polaris A3. This makes over $1.3 billion available for the whole Fleet Ballistic Missile program in Fiscal 1961, $30 million more than Congress earmarked for it. The extra money was shifted from a shipbuilding fund.

Air Force has more money for Samos. Original $200 million budget was increased $50 million last month. Now another $33.8 million has been added.

Defense already has released $83 million for Lockheed C-130Es for MATS interim modernization. There is $117 million more available for USAF when it decides on the second type of aircraft it wants for interim modernization.

Air Force also has shuffled its budget to provide $10 million to begin a 1,500 mi. tactical missile program. Tactical Air Command has studied both cruise and ballistic missile types for this program.

USAF has added $29.4 million to the Skybolt budget, bringing it to $80 million for Fiscal 1961. Project Pluto nuclear ramjet budget has been doubled to $14 million. The X-15 program has been increased $2.6 million to an $8.6 million total, and the Dyna-Soar budget is up $8 million to a $58 million total.

Critics Criticized

Republicans are turning the legitimacy of defense criticism into a major campaign issue at the same time that they are increasing the defense effort. Vice President Richard Nixon and other campaigning Republicans are finding it popular to attack Democrats criticizing U. S. military stature, or foreign policy, especially when Soviet Premier Nikita Khrushchev is visiting the United Nations.

Sen. William Fulbright counterattacked for the Democrats last week, charging that Nixon is asking them to "join him in a conspiracy of silence or misrepresentation." Sen. Fulbright accused Nixon of trying to make criticism of foreign policy a disloyal act. But he said Democrats "would be disloyal if we failed to discuss it as fully and clearly as possible."

Increasing government and industry interest in satellite communications was evident last week in the visit of Federal Communications commissioners to Bell Telephone Laboratories at Holmdel, N. J., to witness an Echo relay experiment. Much of the current interest has been prompted by the success of the Echo project.

FCC currently is considering industry applications for specific frequencies to use exclusively with communications satellites. American Telephone & Telegraph Co., BTL's parent firm, is one of several applicants. The record in the case is voluminous, and FCC doesn't expect to reach a decision for several months.

Latest Canadian proposal to make U.S.-Canadian defense production sharing more of a reality involves a trade of CL-44 transports for U. S. radar installations. Canadians would buy $150 million worth of radar sites and electronics installations the U. S. has built in the Canadian arctic. In return, the U. S. would buy 50 of the Canadair turboprop cargo transports, costing $150 million, for MATS.

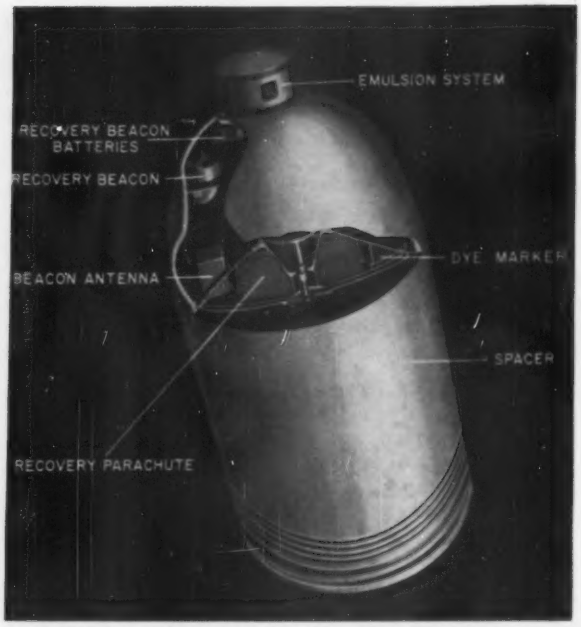
Col. A. I. Karstens has replaced Col. John P. Stapp as head of WADD's Aerospace Medical Division in Dayton. Col. Stapp has been assigned to the Aerospace Medical Center at Brooks AFB, Tex., as special assistant for advanced aerospace studies.

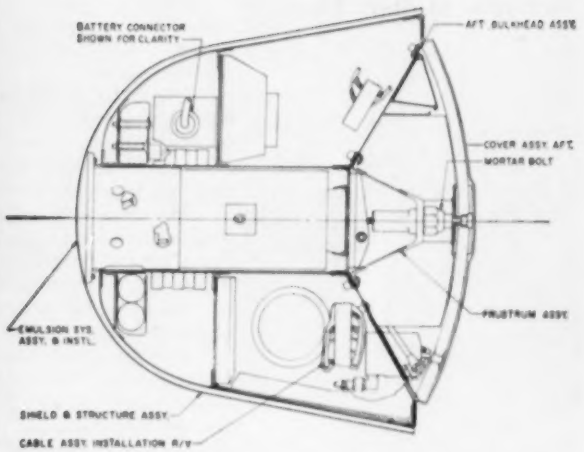
Caribbean Politics

Rep. Overton Brooks is urging the State Department not to disturb the Atlantic Missile Range Station in the Dominican Republic. Rep. Brooks, chairman of the House Science and Astronautics Committee, is concerned that State may decide to close the station as part of the diplomatic sanctions planned against the Dominican Republic under a recent Organization of American States agreement.

Initiative is with the U.S., since the Dominicans have not raised any objections to the station. The station has no tracking role, and it is one of the least vital in the AMR chain. It serves to boost the signal on the submarine cable between Cape Canaveral and Puerto Rico, and this function could be transferred to another island in the general area without much trouble.

—Washington Staff




BATTERY CONNECTOR SHOWN FOR CLARITY
AFT BULKHEAD ASSY.
COVER ASSY AFT. MORTAR BOLT
FRUSTRUM ASSY.
EMULSION SYS. ASSY. & INSTL.
SHIELD & STRUCTURE ASSY.
CABLE ASSY INSTALLATION R/V

NUCLEAR EMULSION RECOVERY VEHICLE (NERV) was recovered last week after attaining an altitude of 1,200 mi. over the Pacific Missile Range. The NASA nose cone was developed by General Electric's Missile and Space Vehicle Department.

Space Technology

U.S. Gains Skill in Space Capsule Recovery

NERV capsule recovery shows valuable role ships, aircraft play in making space programs pay off.

By Russell Hawkes

Pt. Mugu, Calif.—Successful recovery of National Aeronautics and Space Administration's NERV (nuclear emulsion recovery vehicle) by Pacific Missile Range aircraft and ships of Navy's First Fleet points up the growing skill of U. S. forces in conducting the massive and complex recovery operations needed to make many space programs pay off.

NERV shot was the first NASA launch from PMR and was the first flight of the unguided, four-stage Argo D-8 launch vehicle. NASA had three more Argo D-8s at PMR to use if the first NERV shot failed, but since the capsule was recovered and no further NERV shots are planned, these vehicles probably will be released to other programs.

Success of the NERV experiment depended completely on recovery of the capsule, since data could not be telemetered from the nuclear emulsion payload. It will take four to six weeks to reduce the data from the experiment.

NASA concluded on the basis of a series of computer exercises that the Argo D-8 could launch the NERV capsule into a 160 mi. square area around a target point coded Pt. Zulu, 1,200 naut. mi. south of the launch pad at Naval Missile Facility, Pt. Arguello.

The PMR operations office established an expanded secondary search zone 240 mi. square around the primary zone.

The capsule landed 119 mi. east of Pt. Zulu, near the edge of the expanded search area. A Lockheed WV-2 search aircraft from the recovery force was patroling over the capsule when it was retrieved a little more than 2 hr. after launch by the destroyer USS Rowan.

The NERV capsule was launched Sept. 19, parallel to the geomagnetic lines of force and to an apogee of 1,200 naut. mi. to gather information about the lower Van Allen radiation belt. The main instrument in the capsule was a stack of 25 wafers of nuclear emulsion with an average thickness of 600 microns rotating inside a cylindrical tungsten shield. A 1 sq. cm. port in the shield admits ionizing particles with energy levels over 5 MEV. The tungsten cylinder prevents particles of less than 150 MEV from entering the emulsion chamber except through the port.

As the vehicle climbed above 300 mi., a motor extended the cylinder in front of the capsule nose cone. As it descended past an altitude of 600 mi., the motor retracted it. When retracted, the cap on the front of the cylinder formed part of the capsule's ablative heat shield. Also on board was a culture of unprotected mold spores. Experimenters will correlate mutation rate among them with radiation intensities measured by the stack of emulsion wafers. A micrometeorite experiment was dropped from the payload at the last minute.

The solid propellant Argo D-8 vehicle was assembled by Aerolab Development Corp. It is 62-ft. long and weighs about 13,000 lb. The first stage is a Thiokol Sergeant, assisted by a pair of smaller Recruit rockets. Second and third stages are Lance rockets made by Grand Central Rocket Co. The final stage is an Allegany Ballistics Laboratories X-248. A burnout velocity of more than 12,000 mph. was attained 95 sec. after liftoff.

CYLINDER containing nuclear emulsion which records radiation in NERV payload is adjacent to technician's hand. Vehicle's cover is at right; recovery parachute is behind it.

Notable features of the successful recovery were its detailed planning and the careful timing of aircraft operations to get long and continuous availability of at least one airplane over the capsule. The forces involved in the operation, called Task Group 192, were two Lockheed WV-2 early warning aircraft stripped of non-essentials to carry maximum fuel, a Lockheed Electra turboprop leased from Lockheed aircraft and flown by a civilian crew headed by Lockheed test pilot Herman Salmon, the destroyers Rowan and Gurke, and the attack transport Paul Revere, carrying a helicopter.

The use of fleet units in the surface recovery force is rare because they are usually tied up by their own commitments. The Rowan was able to cover the 76 mi. between its original station and the impact point in about 2 hr. It is questionable whether one of the converted cargo ships ordinarily used for missile range work could have reached the impact point before the last search aircraft was forced to leave the scene due to fuel shortage. This would have meant loss of visual contact and would have increased the probability of failure.

The three ships left San Diego several days before the shot and the destroyers were refueled at sea by the Paul Revere. They were on their respective stations 6 hr. before the shot. Launch of the NERV was postponed 1 hr. from the intended time of 7:30 a.m. because the ships reported fog and low stratus clouds in the morning.

As is customary with fleet units, their operations plan included tactics to deal with hostile submarine contacts, evasive maneuvers to be used, and measures to be used under nuclear attack.

The Revere, carrying the task group commander and a staff of NASA technicians, was stationed 30 mi. west southwest of Zulu. Gurke was in position 60 mi. north of the target and Rowan was 40 mi. to the southeast.

The three aircraft were flown to Miramar Naval Air Station from PMR headquarters at Pt. Mugu and from the Lockheed plant at Burbank the day before the shot. Miramar is somewhat closer to the target and has a longer runway than Pt. Mugu. It allowed the search aircraft to take off with a full load of fuel so as to have maximum time on station. The WV-2 went off at 145,000 lb. gross weight—1,000 lb. less than what cockpit placards term "maximum overload gross weight."

First Takeoff

Takeoff of the first WV-2, identified by the radio call sign Girdle 41, was set for 3 a.m. PDT, the day of the launch. At the cruise speed offering maximum fuel economy, this would put it on station 55 mi. south of Zulu at 8:58 a.m. PDT, the estimated time of impact. The second WV-2, identified as Girdle 42, took off at 4 a.m. to be 125 mi. north-northeast of Zulu at the predicted impact time. The Electra, took off much later because of its faster speed.

Girdle 41 nearly failed to make the operation because of trouble discovered in a newly replaced engine the day before the shot, but the trouble was cleared up and the airplane reached

ARGO D-8 four-stage, 63-ft. solid propellant rocket boosted NERV from Naval Missile Facility, Pt. Arguello, Calif. The vehicle is 62-ft. long and weighs 1,300 lb.

Soviet Dogs 'Normal' on Return From Orbit

Zurich—Two small Soviet dogs successfully recovered from space (AW Aug. 29, p. 28) apparently suffered "no deterioration" in muscular coordination during their weightless state in 18 orbits around the earth, according to Russian bioscientist N. M. Rudnyi.

Rudnyi, a member of the Soviet Academy of Scientists, told delegates to the Second International Congress of the International Council of the Aeronautical Sciences here that the two dogs, Belka and Strelka, demonstrated "normal reflexes and normal activity during the flight."

Upon release from their capsule after re-entry, the dogs were "agile, had a good appetite and responded to their names readily," Rudnyi said. Although the two dogs still are under constant observation, Rudnyi said that thus far there have been no deviations from the normal.

The animals, who were fed automatically twice a day and had showed no weight loss upon their return, were monitored throughout the flight by a television camera, and all changes in behavior were recorded. Rudnyi said the dogs appeared frightened during the launch and early acceleration, primarily because of engine noise. During the final stages of acceleration, he said the dogs hung listless and motionless. They returned to normal, however, once in orbit.

Rudnyi termed the capsule payload "a version of a cabin being developed for manned flight." U. S. observers here said there appeared to be no reason why the same model could not support a human in orbit.

At the time of payload separation, Rudnyi said the payload had slowed to a speed of approximately 485 mph. and that its velocity upon impact was about 223 fps.

Barometric pressure within the capsule during orbit was maintained close to that of sea level, according to Rudnyi. Oxygen content was between 20 and 25% and the carbon dioxide level never exceeded 1%.

Miramar 7 hr. before it was due to take off.

The Argo D-8 and its payload were successfully launched from Arguello at 8:35 a.m. in fog and low clouds. About 10 min. later, a "quick look" impact prediction was radioed to the recovery task group over the single sideband net indicating impact would occur 150 mi. southeast of Zulu. Seventeen minutes after launch the task group received a final impact prediction placing impact 11 mi. closer to Zulu. Actual impact was 20 mi. closer than predicted. The predictions were made by an IBM 709 computer drawing inputs from an FPS-16 radar tracking a C-band beacon mounted in the adapter between the final stage of the Argo vehicle and the NERV payload.

The powered flight trajectory of the Argo D-8 is stabilized by a spin rate of about 600 rpm. The spin of the payload must be reduced to below 40 rpm. for a stable re-entry and parachute deployment. The de-spin mechanism is a pair of weights on the end of 130-in. cables wound around the adapter section. As the cables unwind and the weights move away from the vehicle, the spin rate slows. The de-spin operation starts at an altitude of about 600 mi. as the vehicle re-enters and a few moments later explosive tie-down bolts fire and loaded springs separate the capsule from the adapter and the final stage. The spring action also tumbles the capsule. It is aerodynamically stable and dynamic pressure of the atmosphere quickly points the ablative heat shield into the relative wind.

As the deceleration reached 5g during re-entry, a timer was tripped to stream a 6.7-ft. diameter parachute. As the capsule passed through 40,000 ft., the chute was allowed to open fully and the descent continued at an average sink rate of about 50 fps. Alternate gores of the parachute were aluminized and painted international orange. The aluminized gores increase the radar reflectivity of the chute. When the parachute blossomed, the vehicle dumped 1.4 lb. of S-band chaff to aid radar acquisition.

Ten seconds after the parachute deployed, the capsule timer activated a flashing strobe light and a pulse modulated UHF recovery beacon. The capsule carried two blocks of green fluorescent marker dye to assist search forces in making a visual sighting after the capsule entered the water.

Girdle 41 acquired the beacon signals almost immediately on its passive electronic countermeasures receivers and began to home in on them. At about the same time, the destroyer Rowan reported radar contact with the parachute. The Paul Revere and Girdle 42 both held the beacon signals briefly at about 9:10 before the capsule dropped below the horizon. Girdle 42 was still 210 mi. distant from the impact point.

At 9:34, Girdle 41 reported that ECM gear showed that the aircraft was directly over the capsule. Let-down was continued through a thin cloud deck and visual search was started. At 10:17, Girdle 42 passed over the beacon and joined the visual search.

On two passes, Girdle 41 dropped smokelights in the water as the beacon bearing began to shift rapidly from ahead of the airplane to behind it. On the next pass, the green dye marker and the 19-in. dia. capsule were sighted midway between the two smokelights which provided the necessary visual references.

Girdle 41 returned to Pt. Mugu shortly after the sighting. Girdle 42 remained over the capsule until the Rowan completed its 76-mi. dash and fished the capsule out of the water and turned the beacon off at 11:26 a.m. The capsule had been in the water a little more than 2 hr.

Plug Nozzle Contracts

Washington—General Electric has been awarded more than $1 million in USAF contracts to investigate plug nozzle configurations for use on solid and liquid propellant rockets. GE has explored this type of nozzle in the past both with company funds and under National Aeronautics and Space Administration sponsorship (AW Feb. 1, p. 16). Solid work, to be done at the Evendale, Ohio plant, will include improved methods of controlling thrust magnitude and direction. Liquid work will be done at the Malta Test Station in New York.

Eisenhower Asks UN To Ban Space War

Washington—President Eisenhower proposed last week that the nations of the world agree to ban sovereign claims to or warlike acts on celestial bodies and ban the stationing in space of weapons of mass destruction. He said "all launchings of spacecraft should be verified in advance by the United Nations."

In a speech to the UN General Assembly, the President also urged international cooperation for peaceful uses of outer space under UN direction. He said the U. S. is ready to resume disarmament negotiations and proposed that all nations end nuclear weapon production and dispose of current weapons. The President suggested a UN "surveillance body" that could intervene in times of crisis to reduce danger of war by miscalculation. Political willingness of countries to submit to inspection—not technical feasibility of such a plan—is the vital issue, the President said.

He also called again for consideration by "an impartial tribunal" of all the facts in Russia's shooting down of an Air Force RB-47 reconnaissance plane. These proposals were among a number which the President placed before the UN in a plea for specific efforts toward world peace.

USAF Launches First Blue Scout Vehicle

By Michael Yaffee

Cape Canaveral, Fla.—Air Force launched the first of its family of Blue Scout rockets last week to begin development testing that is expected to be followed by an operational pace of 35 shots a year.

The vehicle, designated Blue Scout, Jr., was the first firing in the Hyper Environmental Test System 609A program (AW July 11, p. 54). The four-stage, solid-propellant rocket was launched at a 70 deg. angle and was intended to boost a 32.8-lb. payload to an altitude of approximately 16,600 mi.

Impact area was calculated to be south and east of Ascension Island, approximately 7,000 mi. downrange from the launching site at Cape Canaveral. Although telemetry contact with the vehicle was lost 8 sec. prior to burnout of the fourth state engine, preliminary indications were that the vehicle followed its prescribed course and fulfilled its mission. No effort was made to recover the payload which was expected to burn during re-entry.

Telemetry Data

Complete readout of the taped telemetered data was expected to take several days. Data telemetry from instrumentation in the payload package, a secondary objective of this flight, was not obtained. Original plans called for data from vehicle performance instrumentation to be telemetered through burnout of the fourth-stage engine.

After burnout of the fourth-stage engine, at extreme altitude, payload instrumentation was to be switched onto the vehicle's four telemetry channels.

Only previous Scout vehicles to take to the air were launched by the National Aeronautics and Space Administration from its Wallops Island launch site (AW July 18, p. 140).

Primary purpose of last week's flight, which was the first of a 12-vehicle Blue Scout test program to be carried out at the Cape within the next 12 months, was to check out the vehicle itself including such phases as separation and launching techniques. All Blue Scouts, however, will carry instrumented payloads, some designed for recovery, which will be supplied by various Air Force research centers and other military and civilian agencies.

Two of the next 11 Blue Scouts launched here will carry satellites. Later payloads will include winged boost-glide models for the Dyna-Soar program. After the initial development program, Air Force expects to fire approximately 35 Blue Scouts a year.

Payload for last week's flight was supplied by Air Force's Special Weapons Center. It consisted of a neutron detector, two Geiger counters, a prototype device used to detect low energy charged particles in the Van Allen radiation belt, and a magnetometer for determining the aspect of the instrument package with reference to the earth's magnetic field.

On later flights in which the Blue Scout, Jr., is expected to carry somewhat lighter payloads of 25-26 lb. to approximately 40,000 mi. altitude, the prototype device will be used to measure X-rays.

Last Wednesday's payload will be duplicated in another Blue Scout, Jr., to be launched shortly.

The vehicle was launched at 8:02 a.m. Sept. 21. It was scheduled for launch any time from 8 a.m. to 9:50 a.m. Temperature considerations necessitated the 1 hr. 50 min. cutoff time. To conserve payload weight, the Air Force used paint instead of a more effective, but heavier, temperature control mechanism to keep temperatures within minus 15C to plus 50C.

Configuration of the vehicle is designated 2356. It consists of a Thiokol XM33 first stage motor, a Hercules ABL-X-254-A1 second stage, an Aerojet 30KS-8000 third stage, and a Naval Ordnance Test Station Model 100A 17-in.-dia. spherical fourth-stage motor. Total burning time of all four motors was approximately 3 min.

Payload was attached to an aluminum plate atop a plastic foam form which fitted over the top of the fourth stage motor. The vehicle was unguided. It was stabilized by fins on the first and second stages and spin rockets on the first stage which rotated the vehicle approximately three revolutions per second. The vehicle carried canister destructors in the top of the first-stage and bottom of the second-stage motors.

Launch Sequence

The vehicle, which is serviced by a boom rather than a gantry tower, was raised from a horizontal to an upright position at T—40 min. Upon ignition the vehicle rises within an acceleration reported only as "greater than that of the Polaris." The heat shield is separated and discarded after second stage burnout. After the heat shield is jettisoned the antennas flip out. At this point, the third-stage motor, fourth-stage motor and payload are sitting in a tube from which they are ejected upon ignition of the third-stage motor.

After third-stage burnout, the fourth stage ignites and separates from the third stage by means of a blast diaphragm.

Blue Scout, Jr., is the smallest of the three configurations that made up Hyper Environmental Test System (HETS) 609A, Air Force designation for the family of low-cost, versatile solid-propellant research vehicles derived from NASA Scout vehicle systems. The vehicle stands about 40 ft. high and weighs about 14,000 lb. Over-all, Blue Scout, Jr., has a total thrust of more than 50,000 lb., a maximum altitude of 20,000 mi. and a maximum velocity in excess of 20,000 fps. Cost, including servicing and launching, is expected to be well under $500,000, according to Air Force.

Blue Scout, Jr., originated as part of USAF Special Weapon Center's Journeyman-B program.

Of the 11 Scout vehicles that the Air

Second Atlas Fired 9,000 Mi.

Cape Canaveral, Fla.—Air Force succeeded last Monday in sending a second Atlas re-entry vehicle 9,000 stat. mi. down range and into the Indian Ocean. A 5½ hr. delay in launching was experienced.

The delay, which reportedly was caused by a propellant vent valve that would not close, forced postponement of a Snark firing, scheduled to follow the Atlas launch, until later in the week.

Purpose of last week's flight was to test extreme range performance of the missile's propellant utilization system, General Electric guidance system, and Mk. III re-entry vehicle. No attempt was made to recover the re-entry vehicle and the results of telemetered data were not made known. There were some questions raised concerning survival of the re-entry vehicle which is an improved version of the Mk. III vehicle used on the previous 9,000-mi. Atlas shot last May 20 which reportedly caught fire during re-entry.

Vehicle fired last week was Atlas 79D. It weighed approximately 1,000 lb. more than operational Atlas configurations, therein indicating that an operational vehicle could travel significantly farther.

The flight was plotted entirely over water between South America and the Cape of Good Hope. Air Force reported that the missile reached an apogee of approximately 1,000 mi. during the flight.

Force plans to launch from the old Vanguard pad here within the next 12 months, four will be Blue Scout, Jr., types, five will be Blue Scout-Is, and two will be Blue Scout-IIs.

Blue Scouts I and II will stand about 75 ft. high, weigh in the neighborhood of 35,000 lb., will have a maximum velocity in excess of 20,000 fps., and a maximum vertical range of 6,000 mi. (due to heavier payload). Both will probably use an Aerojet 30KS-120,000-lb. solid propellant first-stage engine with a thrust of more than 100,000 lb., a Thiokol XM33 second stage and a Hercules ABL-X-254 third-stage engine. Both Blue Scout I and III will be launched vertically and are expected to cost more than $500,000 each, with servicing and launching.

For control, the first stage will have movable fin tips and jet vanes. Upper stages will use small hydrogen peroxide jets. Main guidance will come from a programed autopilot.

Blue Scout II will be a four-stage vehicle which will probably use the small ABL-X-248 for the fourth-stage engine. Essentially, it will be a NASA Scout modified slightly for adaption to Atlantic Missile Range facilities. Among other things, for example, the guidance system has been moved at somewhat of a sacrifice in payload capability from the head of the third stage to the fourth stage.

Blue Scout I will be a three-stage vehicle with large payload capacity. Overall structure will be strengthened to enable it to carry heavy payload packages and small boost glide vehicles. For recovery information from the flight, the Air Force reports that a standard data recovery vehicle has been developed for use for all 609A configurations.

This vehicle consists of a heat shield, structural assembly and data capsule, and weighs about 90 lb.

Its configuration is that of a spherically-capped cone which has a base diameter of 21.9 in., a nose radius of 7 in. and a cone half angle of 15 deg.

Primary function of the Blue Scout program is to provide Air Research and Development Command with vehicles for carrying out investigations and experiments in the upper atmosphere and circumterrestrial space in support of military space and weapon system development programs.

Among other things, these vehicles are expected to extend significantly the Air Force's capability for providing booster support for military space systems. Blue Scout will be used to test vertical and angular launch techniques, ballistic boost glide and boost dive trajectories, and recovery techniques. Conceivably, according to one special weapons officer, the Scout could be used to detect radiation from high-altitude nuclear explosions, or conversely, to find areas where nuclear bombs could be exploded with little chance of detection.

Responsibility for direction and supervision of the HETS 609A program which the Air Force initiated in mid-1959 has been assigned to USAF's Ballistic Missile Division.

Blue Scout Operations Division of AFBMD's 6555th Test Wing (development) is responsible for assembly, checkout and launch of specific vehicles with launch support provided by Missile Test Center.

Ford Motor Co.'s Aeronutronic Division is the prime associate contractor for 609A projects with responsibility for general system engineering and integration, for design, development and fabrication of the payload carrier and for conduct of the launch operation at the Atlantic Missile Range. Chance Vought's Astronautics Division provides the inter-stage hardware, ignition and emergency destruct system. Minneapolis-Honeywell's missile development laboratory is responsible for guidance and control systems, including auxiliary power.

Project Saint Briefing

Approximately 18 industry members attended a briefing early this month on requirements of Project Saint, a satellite intercept system involving the use of an interceptor satellite which would be put into same orbit as, or very close to, that of an "unknown" possibly hostile satellite, to identify the latter and destroy it if hostility is established. Likelihood is that in the initial program, only the interception capability will be developed, with considerably advanced followup phase for developing the destruct capability. Saint is an Advanced Research Projects Agency program under general cognizance of Air Force's Ballistic Missile Division with Aerospace Corp. supplying technical supervision.

NASA Organizing Medical Team For Mercury Tracking, Recovery

By Edward H. Kolcum

Washington—Medical group of about 160 military and civilian specialists is being organized to serve with Project Mercury tracking and recovery forces.

Organization of the medical force, now nearing completion, is based on recommendations of a medical review group of top research and practicing physicians which studied medical aspects of the Mercury recovery plan for the National Aeronautics and Space Administration.

Study recommended that medical specialists associated with the Mercury tracking and recovery effort include surgeons (general, orthopedic, plastic, neuro), pathologists, radiologists, veterinarians, anesthesiologists, internists, genito-urologists; laboratory officers and nurses and technicians.

Recovery force will include about 150 medical specialists from the three military services who will be assigned to NASA during specific missions as part of the Defense Department's Mercury support effort. They will serve at hospitals near recovery areas and on recovery ships.

In addition, a medical monitor will be stationed at each of six tracking stations. They will be a mixture of civilian and military physicians who have the relatively unique qualification of experience in observing and interpreting remote measurements.

Civilian physicians will be used in countries where the political climate dictates such a measure to assure foreign governments that Mercury is not a military program. Expressions of doubt in this area have been reported in Africa and Mexico (AW Aug. 29, p. 92).

NASA will use Australian physicians at the Woomera and Perth, Australia, tracking sites.

Medical monitors will work as a team with engineers who will check operation of the Mercury capsule environmental control system. Three physiological measurements will be taken from the astronaut throughout his flight: heart action, respiration and body temperature.

The six environmental-medical teams will be linked with each other, with the communications control element at Goddard Space Flight Center, and with the stations having the command capability to return the capsule from orbit by igniting the retrorocket system. Command stations are Cape Canaveral, Bermuda, Perth, Hawaii, Pacific Missile Range and Guaymas, Mexico.

Medical element in the recovery force, about 50 of them professionals and the remainder technicians, will be detailed in their individual specialties and do not require additional professional training for Mercury duties.

Only existing hospitals will include all recovery force specialties. Ship recovery teams may include as few as three medical men designated specifically to the project. Each ship will have at least a general surgeon, an

Echo Relays Continue

Washington – Transcontinental messages beamed off Echo I were still coming through loud and clear last week, with signal fluctuation running about 6 db., Lt. Col. Robert E. Warren, National Aeronautics and Space Administration, reported here during a symposium on Space Electronics and Telemetry. Originally, signal fluctuation was about 1 db., Warren said.

Tape recordings which Warren played of transcontinental transmission, made during the 314th pass on Sept. 6, sounded better than one made on satellite's second pass on Aug. 12. This apparently resulted from improved ground station antenna orientation tracking which more than compensated for loss of satellite sphericity. Warren said that Echo I's useful life is impressive in view of the fact that it was placed in orbit during a period of intensive micrometeorite showers.

anesthesiologist and a corpsman. Unlike recovery medical personnel whose preparation consists of informal familiarization with the project, monitors are attending special lectures at Space Task Group, Langley Field, Va., and at Cape Canaveral, Fla.

Training is designed to familiarize monitors with detailed medical records and histories of the seven Mercury astronauts, and to indoctrinate these physicians with the capsule and electronics systems.

The recovery group will be stationed at five existing hospitals and on an unspecified number of ships. Although the medical staff detailed specifically to Mercury recovery will number about 150, it is expected that complete medical facilities of these bases and ships will be indirectly committed to the Mercury operation if needed.

Hospital Facilities

Land-based hospital facilities will be used at Cape Canaveral, Grand Turk, Grand Bahamas, Bermuda and the Canary Islands. NASA emphasizes that the medical recovery team will not be involved in data or information collection, but consists of specialists who could logically be called on to attend an astronaut following space flight.

The medical recovery team is being organized under four group surgeons, one of whom will direct medical operations in each of the three high-probability landing areas, with the fourth in charge of operations for six low-probability landing areas.

High-probability landing areas are the desired sector off Puerto Rico, an area off Cape Canaveral where the capsule would land after a launch abort and an area off the Canaries, where the capsule would descend if orbit were not achieved after a good launch.

Military personnel designated for Mercury are selected by NASA from a list of specialists furnished by the Defense Department. Surgeons general of the individual services make the initial selection of the medical personnel for Mercury, and NASA says final selection has been about evenly divided among Air Force, Navy and Army medical personnel.

USAF Decentralizes Management Of Weapon System Development

Washington—Air Force has given more freedom of action to its System Program Offices (SPO's) to accelerate weapon and support system development and implementation by decentralizing authority previously held by USAF headquarters.

The new policy, announced last week, is the result of a year-long study by a group of seven top USAF officers headed by Gen. Samuel E. Anderson, Air Materiel Command chief.

There is no change in the transition point for transferring program direction from Air Research and Development Command to the AMC, a hotly debated question during the study. Decision will be handled on an individual program basis at the System Program Office level, unless agreement cannot be reached. In such cases, the decision will move to the USAF Weapons Board or up to the Air Council, an Air Force spokesman told Aviation Week.

Regulations Issued

Statement of new Air Force management policy and philosophy is contained in a new series of regulations, three of which have been issued to date: AFR 375-1, -2 and -3. Additional regulations in the series, which will detail and amplify the first three, are now in the draft stage.

Under the new regulation, the former Weapon System Project Office (WSPOs) and Electronic-Support System Project Offices (ESSPOs) are renamed System Program Offices, each headed by a System Program Director.

The new decentralization of program management authority is patterned after that adopted by many of the larger corporations, such as General Electric and General Motors. Here, the general manager of a decentralized department or division operates almost as autonomously as the president of a small company, within a framework of authority established by corporate officials.

The Air Force's System Program Directors, equivalent to decentralized general managers in industry, will be responsible for planning, organizing, coordinating and monitoring the activities of all field agencies participating in their respective programs and for directing them toward system objectives.

Authority which will be retained by USAF Headquarters covers changing operational concepts, operational dates, specific requirements and increasing program budget.

USAF Headquarters also may, if it wishes, give the System Program Director the following additional authority:

- **Rescheduling** of programed events or actions if required to promote a better balance in the effort.
- **Reapply funds** authorized for the system to achieve a better balanced program.
- **Make trade-offs** between approved performance parameters, or between these parameters and costs or schedules, consistent with guidance received from USAF Headquarters. Such trade-offs are limited to parameters which do not affect over-all system performance as established in the specific operational requirement. For example, a System Program Director would not have authority to make a trade-off affecting minimum range or maximum weight of an airplane or missile.

System Program Directors will report on status of their programs through their responsible command, i.e. ARDC or AMC, with periodic total program status reports to USAF Headquarters.

Where systems involve efforts of more than one of the three major centers (AMC and ARDC centers at Inglewood, Calif., Dayton, Ohio, and Bedford, Mass.), liaison will be provided by field offices located at each of the three centers, which will be operated under a systems staff office at USAF Headquarters.

Some Concern

There is some concern that the new policy giving each System Program Director increased authority could result in coordination problems between System Program Offices working on different systems which must operate together or share common support system facilities. Subsequent regulations in the basic AFR 375 series are expected to deal with this subject. This would include the question of when the Program Director of one system is required to use the product being developed by another SPO and when he is free to make his own procurement of such facilities in the interest of over-all time or dollar savings.

Defectors Termed No Threat to U.S. Codes

Washington — House investigators tentatively concluded last week that the two National Security Agency defectors—Bernon F. Mitchell and William H. Martin—can assist the Soviet Union in perfecting its own intelligence communications system, but not in cracking U. S. codes and ciphers.

A special House Armed Services investigating subcommittee, headed by Rep. Paul Kilday (D.-Tex.), reached this conclusion following executive sessions with top officials of Central Intelligence Agency and Department of Defense, including NSA, Army's G-2, Office of Naval Intelligence, and Air Force Office of Special Investigations. The subcommittee has suspended hearings to afford time for members and staff to study the record.

Rep. Kilday said: "It appears as if Mitchell and Martin are in a position to aid the Russians in making Russian intelligence more secure, they are not in possession of information which renders our own intelligence insecure. It appears at this point that our own code and cipher are still secure."

Rep. Kilday added that subcommittee members "have been assured that these two traitors were engaged in work pertaining to the more efficient mathematical processing of foreign statistical data"—rather than work on U. S. intelligence communications.

Mitchell and Martin, who presented details on NSA monitoring of intelligence flights and on NSA organization at a Moscow press conference Sept. 6 (AW Sept. 12, p. 37), were accepted for assignment as mathematicians to NSA's Office of Research and Development in July, 1957, and were granted access to information classified top secret on a need-to-know basis in September, 1957. They worked in this office, one of NSA's four offices, until their defection last June.

At the international press show in Moscow, Mitchell and Martin detailed the activities of the NSA Office of Research and Development, subdivided into these three branches:

- **REMP**—conducts cryptanalytical research and works on applied cryptanalytic problems without restriction as to country, provides consulting services to other divisions of NSA, carries out research in computer componentry.
- **RADE**—designs radio receiving and transmitting devices, radio direction finders, radio fingerprint apparatus, studies unknown communications systems.
- **STED**—studies possible weakness of cipher machines in general, assists COMSEC in the design of cipher machines for U. S. use, studies the process of enciphering speech." COMSEC—NSA's Office of Communications Security—"is responsible for the production and security of U. S. cipher systems," according to Mitchell and Martin.

In addition to the subcommittee finding on the impact of the defection, Kilday made these observations after the executive sessions:

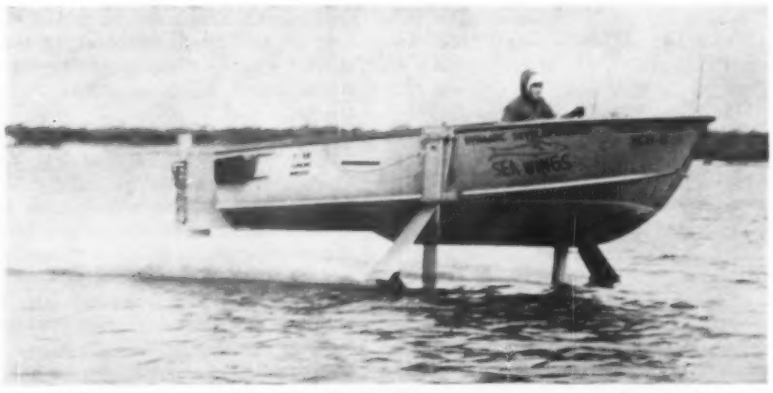
- **"NSA states** that at no time prior to publication in the press on May 1 was any information whatsoever relative to U-2 operations available to either Martin or Mitchell." Rep. Francis Walter (D.-Pa.), chairman of the House Un-American Activities Committee, previously stated that one of the two defectors asked for information about the flight of the Lockheed U-2 reconnaissance plane before it was downed near Sverdlovsk, USSR, last May 1, but he did not state whether the defector received the information before that date.
- **"From an examination** of information in the possession of NSA at the time of the employment of Mitchell and Martin, it is my personal view that neither should have been employed in a sensitive agency. That information showed them to be unstable, even though specific acts of culpability were lacking." The information was based on investigations of both defectors by naval intelligence in connection with their employment as naval cryptologists in Japan from 1952-54, investigation of Martin by naval intelligence in connection with his 1957 NSA employment, and investigation of Mitchell by Air Force intelligence for NSA employment in the same year. The information was evaluated by NSA.
- **Reporting that** when the "parting statement" of Mitchell and Martin was disclosed in a Maryland bank deposit box early in August he urged Deputy Secretary of Defense James Douglas to release it, Kilday commented: "It was a mistake to conceal the statement. This gave the Russians a propaganda advantage in its release by them."

NSA Organization

In addition to the Office of Research and Development and the office of communications security (COMSEC), the two main divisions of NSA are the Office of Production and the Office of Security. The latter is responsible for NSA personnel. Mitchell and Martin detailed the activities of the Office of Production which they said receives intercept material from the out-stations as follows:

- "**ADVA**—studies high level Soviet cipher systems and diplomatic codes.
- "**GENS**—studies Soviet military code systems and medium level cipher system.
- "**ACOM**—studies the code and cipher systems of Asian Communist nations.
- "**ALLO**—studies the code and cipher systems of U.S. allies, neutral nations and some Communist nations.
- "**MPRO**—provides electronic digital computing and data processing services to other divisions of NSA."

Witnesses before the Kilday Subcommittee included J. Vincent Burke, Defense Department general counsel, in charge of a separate Defense investigation of the defection; USAF Gen. C. P. Cabell, who served as staff director



Grumman Hydrofoil Demonstrates Speed

Dynamic Developments XCH-6, built to prove principles of supercavitation (AW Feb. 22, p. 80), roars across the water near the company's Babylon, N. Y., plant in trials before its first public demonstration last week at The Hague, Holland. Powered by a single 1,050 eshp. General Electric T58 gas turbine using about 200 hp. to drive a super cavitating propeller, the 23-ft. craft rides on supercavitating hydrofoils. Guaranteed speed of the XCH-6 is 70 mph.; during its development program it has reached 50 mph. Dynamic Developments, Inc., is an affiliate of Grumman Aircraft.

of the Joint Chiefs of Staff before becoming deputy director of CIA in 1953; Robert Bannerman, deputy director of CIA for security; USAF Brig. Gen. Edward G. Lansdale, deputy assistant to the Secretary of Defense for special operations; Dr. Louis W. Tordella, deputy director of NSA; Maurice Klein, NSA director of personnel, and Army Maj. Gen. Richard Collins, until recently director of security mapping and combat intelligence, who will become a member of the United Nations command in Korea on Nov. 1.

Officers Testify

Brig. Gen. Charles Leonard, deputy director of Army's security mapping and combat intelligence; Rear Adm. L. H. Frost, director of naval intelligence, who is scheduled to take over as director of NSA on Nov. 24 when Air Force Lt. Gen. John A. Samford retires, Rear Adm. Vernon L. Lowrance, who will succeed Adm. Frost as director of naval intelligence, and Brig. Gen. John Breit, director of USAF intelligence, also testified.

Civil Satellites Coordinator Appointed

Washington—Robert G. Nunn, Jr., has been appointed to coordinate national and international elements of civilian communications satellites by the National Aeronautics and Space Administration.

The move comes as industry is pushing efforts toward a commercially feasible satellite relay (see p. 25) following the highly promising results being obtained from the Echo I passive test sphere. NASA anticipates that communications will produce the first utilitarian benefit from space research (AW Aug. 8, p. 21).

An attorney, Nunn has been assistant general counsel at NASA. In his new job, he is special assistant to T. Keith Glennan, NASA administrator, in a post established to cope with nonmilitary and non-technical policy problems associated with satellite communications.

A major policy problem which must be resolved before this technique reaches a practical application is establishment of roles of participants, including industry, the Federal Communications Commission, which allocates communications frequencies, the Defense Department, which operates launch sites, and foreign interests, which will be affected by transoceanic communications.

Industry participation requires definition in the areas of company-funded research and development and selecting the point at which the system will shift to commercial use.

Hardware, Training, Operation Plan Takes Shape in Dyna-Soar Project

By Larry Booda

San Francisco—Dyna-Soar boost glider program, on which Air Force is pinning its hopes for development of a true space weapon system, is sufficiently advanced that hardware features have been specified, training programs scheduled and operational techniques outlined.

Although hardware will be subject only to minor changes in the future, training and flight programs will be adjusted as operating experience dictates.

The shift in emphasis from reconnaissance systems and passive satellite detection to true manned and unmanned weapon systems was the dominant theme as speakers and panelists at the Air Force Assn. convention here outlined the future role that military space vehicles may play in deterring aggression.

Although Phase I of the Dyna-Soar program takes it only through suborbital flights (AW May 9, p. 26), it is hoped that the program eventually will provide the technology for space weapon systems that can fly within the atmosphere, orbit the earth or maneuver in space at superorbital velocities.

Phase I will include air drops of unmanned and manned Boeing gliders and long-range, suborbital boosts of the glider on a modified Martin Titan-I missile. Missile plus the 9,000-10,000 lb. glider will have a gross weight of 242,000 lb.

This phase now will include crew training in modified Lockheed F-104s, dropped from a Convair B-58 at the highest altitude the carrier can reach to simulate flight patterns expected from the glider. It has been determined that the F-104 can be given approximately the same powerless glide trajectory and handling characteristics as the Dyna-Soar glider. Original plans were to use the Boeing B-52 as a carrier, but the B-58 has superior altitude performance. This is scheduled to begin in 1962.

Molybdenum has been chosen for most of the glider structure, and all areas that will be subjected to high heating will have an ablative coating underlaid with insulating material. Coolant will be circulated in areas where temperatures are expected to exceed the 2,400F design limit of the glider.

Phase II orbital test flights will test control, flight path computation techniques, and ability of the structure to withstand air friction heating at altitudes from 150,000 to 400,000 ft.

Long-range thinking on the Dyna-Soar contemplates flight to the moon and re-entry into the earth's atmosphere, requiring an extreme precision in flight path control.

Technique would involve intercepting the earth's orbit at 35,000 fps. at such an angle that gravity would not cause too rapid a deceleration—overheating and possibly destroying the vehicle or killing the pilot—and that superorbital centrifugal force would not cause it to miss the desired earth orbit and swing back into a space trajectory.

Re-entry corridor for Dyna-Soar is variously estimated from 8 to 20 mi. in depth. If the vehicle should come in at too high a speed, it could obtain what is essentially a downward lift, pushing it deeper into the atmosphere, by turning upside down and gradually losing velocity until injection into a recovery trajectory was possible.

Lt. Gen. Roscoe C. Wilson, deputy chief of staff for development, said USAF is interested in development of a loiter aircraft that could remain a long time on station, carrying a large air-to-surface missile. He referred to the concept as "an airborne Polaris." None of the aircraft that will carry the Skybolt air-to-surface ballistic missile have loitering capability.

KC-135 Zero-g Flights

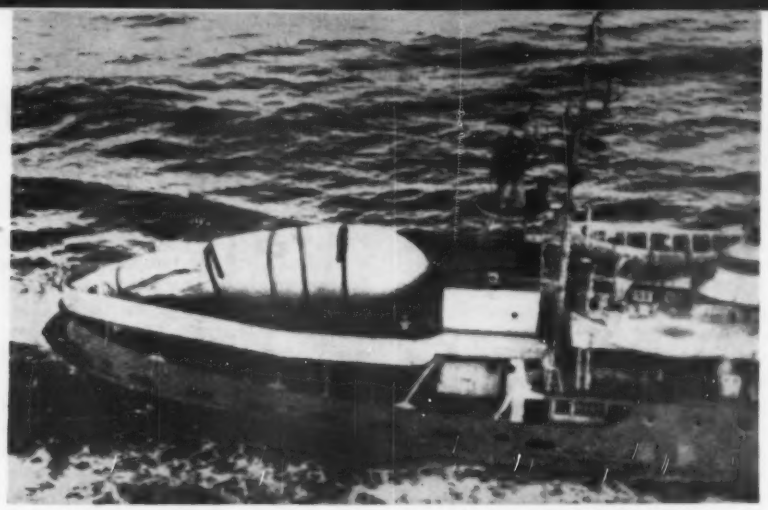
Dayton—Three Mercury space pilots last week were at Wright Air Development Division for weightless flights making first use of a modified USAF Boeing KC-135 for this training. Aircraft provides up to 35 sec. of zero gravity, compared with about 15 sec. in a Convair C-131 used in earlier training. All seven astronauts have flown 45-50 sec. in single zero-g maneuvers in high-performance jet aircraft (AW Jan. 4, p. 22).

JPL Invites Bidders To Tracking Briefing

Washington—Jet Propulsion Laboratory has invited 30 prospective bidders to a conference Thursday and Friday on plans to increase the capability of its Goldstone facility to track and communicate at interplanetary ranges.

The laboratory plans to award two or more study contracts to extend the existing facility. Project will include much larger antenna than the present 85-ft. dish at Goldstone.

The JPL facility is one of three tracking sites which will give 24-hr. coverage of deep space probes. The others are at Woomera, Australia, and Johannesburg, South Africa.



Soviet Tug Carries Balloon on Deck

Soviet Navy fleet tug Kapitan V. Pedotov was photographed in the North Central Atlantic, carrying a blimp-shaped balloon on its after deck. Defense Department said the deck probably would be capable of supporting a helicopter. Ship mounts a wide variety of electronics gear and probably is capable of operations as a range instrumentation vessel.

Two Methods Found To Eliminate Contrails

Washington—Two systems which essentially eliminate the visible contrails behind a jet engine at high altitude have been developed at the Aerophysics Laboratory of Air Force Cambridge Research Laboratories.

Operating principle on one system is to reduce the size of water vapor particles in a jet exhaust so that they are not visible to the eye after they leave the engine and condense in the cold air at high altitudes. Reduction in particle size is accomplished by seeding the exhaust with solid, dust-like particles. The small amount of water vapor which adheres to each dust particle is not visible to the human eye when it condenses to ice.

The second contrail reduction method involves the use of a special fuel which produces less water vapor than JP-4 when it is burned. The probability of producing a contrail is greatly reduced using this fuel because a minimum amount of water vapor is required to form a contrail.

Air Force plans to install the exhaust seeding system on its manned bombers and to use the special contrail-reducing fuel on the decoy missiles carried by the bombers. Daylight operations with decoys have been difficult in the past because the great difference in bomber and decoy contrail size made the bombers immediately distinguishable.

Seeding system has been tested successfully on a B-47 bomber (AW Sept. 19, p. 27).

Use of the special fuel by bomber units was rejected because of logistic problems. Weight of the exhaust seeding system planned for the Boeing B-52 will decrease range less than 1%. The complete system for all eight engines will weigh about 3,000 lb., of which the seeding material will account for 2,000 lb.

The B-52 system is scheduled to be ready for operational use next June.

Charles E. Anderson was primarily responsible for the contrail-reducing concept, and Seymour J. Birstein was the project scientist.

Contractors which contributed to the five-year project include: Allied Research Associates, Inc., Cornell Aeronautical Laboratory, Armour Research Foundation and Meteorology Research, Inc.

Fair Share Urged For Small Business

Washington—Senate Small Business Committee recommended last week that weapon system contractors be required to justify in writing any failure to afford small firms the opportunity to submit proposals on subcontracts.

The committee, reporting on small business aspects of weapon system contracting, said that the justification should be subject to approval by the contracting officer.

The committee also urged Defense Department procurement officials to bring the advantages of subcontracting with small business firms "constantly and forcibly" to the attention of weapon system contractors.

"For this indoctrination program to be successful in terms of greater utilization of small producers within the weapon system," the committee recommended that "the procurement officials of the military services pay more attention to the intent of Congress that small business firms at all times receive a fair share of government purchases. . . ."

News Digest

Belgian government, which had threatened to cancel its Lockheed F-104G production program because of the economic impact stemming from loss of the Belgian Congo plus bitterness toward the U. S. for its support of United Nations moves within the Congo (AW Aug. 15, p. 32) are paring their total order from a planned 100 to 75 (AW Sept. 19 p. 39). Meeting to reach final discussions on financing, including allocations of U. S. mutual aid funds, was scheduled to be held in Brussels late last week. SABCA, Belgian firm tooling up to assemble Belgium's F-104 plus 89 of the 574 West German aircraft on order, is scheduled to get its program under way by next June, turning out six-to-seven airframes per month.

Eastern Air Lines has sold its entire fleet of 15 Lockheed 749A Constellations, mothballed at Louisville, Ky., since last April, to the Transit Equipment Co. of New York. The purchaser expects to sell or lease the planes on a world-wide basis.

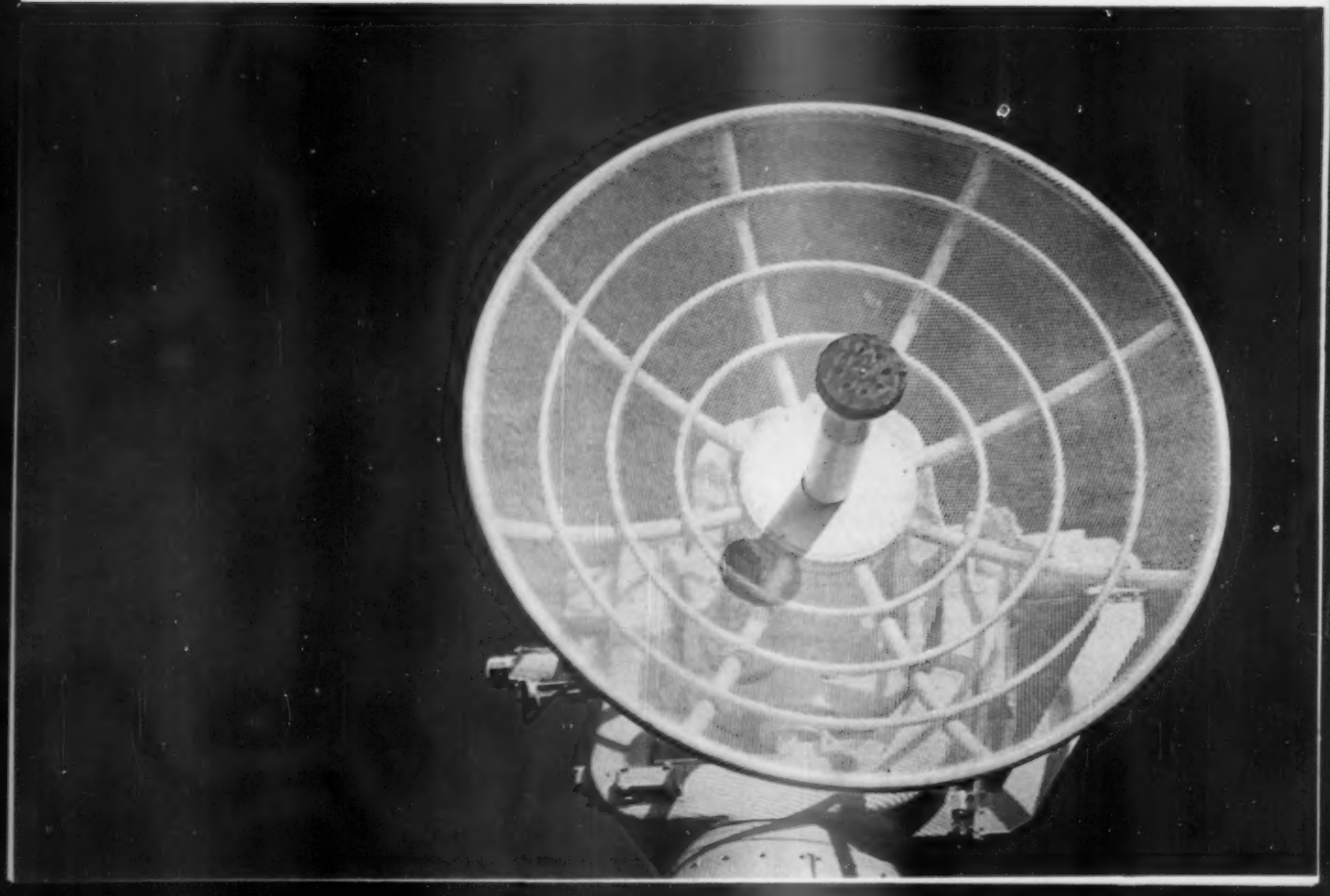
Grumman Aircraft Engineering Corp. delivered the first four production AO-1AF Mohawk turboprops to U. S. Army Sept. 15. AO-1AF is basic configuration which becomes -1BF version with the addition of side-looking radar and the -1CF with infrared surveillance equipment. Grumman has built nine prototype Mohawks, will build a total of 43 -1AF models and 17 each of the -1BF and -1CF.

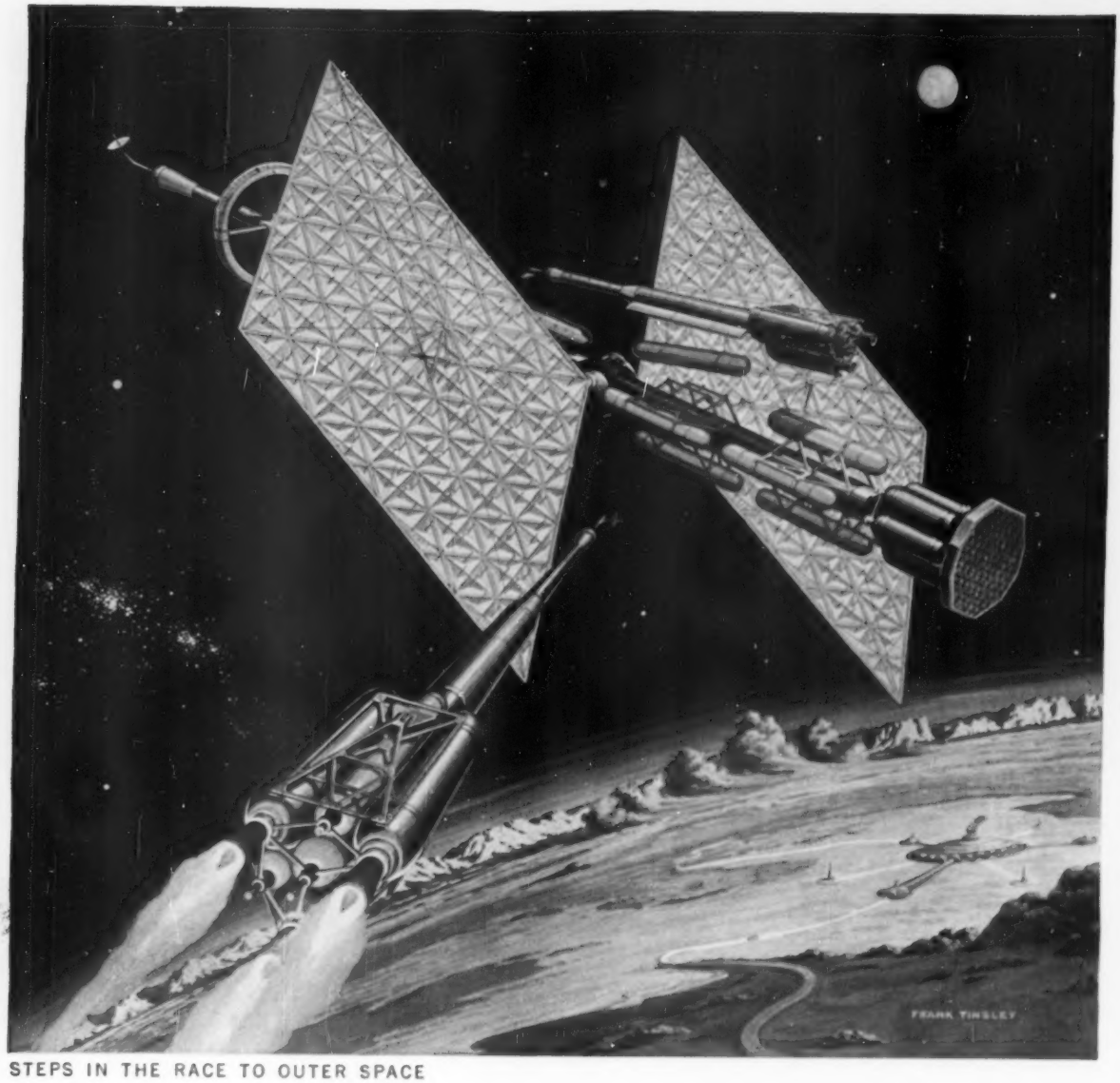
Stuart G. McLennan has been named assistant to Martin Co. Board Chairman George M. Bunker, based in the Washington office. McLennan formerly was manager of Bell Aircraft Corp.'s Washington office.

Chance Vought Aircraft has been awarded $68 million for Fiscal 1961 production of the Navy F8U-2N Mach 2 interceptor, bringing to $162.6 million the total procurement funds committed for the F8U-2N.

Defense Communications Agency has named six semi-finalists in its competition to select contractor to build new Defense National Communication Control Center in Washington (AW Sept. 12, p. 39). Agency hopes to select winner by early October. Those invited to submit cost estimates include: General Electric, Radio Corporation of America and teams headed by The Alpha Corp., Philco, Western Electric and Western Union.

CANOGA IS AT WORK AT EVERY MISSILE RANGE IN THE FREE WORLD!





STEPS IN THE RACE TO OUTER SPACE

Mars Supply Fleet

When man first sets up colonies on Mars, his life will depend on a Mars Supply Fleet, shuttling from Earth at regular intervals with supplies, equipment and personnel.

The fleet will be comprised of two basic vehicle types, both shown in the illustration above. The large ships with rectangular solar reflectors will be the long-range backbone of the fleet. Assembled in orbit of prefabricated sections rocketed up from Earth, these high-capacity carriers will have a low-thrust electro-particle drive. Their operating current will come from thermionic converters, heated by the concentrated rays of the reflectors.

The Solar Ships will be loaded and unloaded, at both ends of the voyage, by work-horse Ferry Rockets (foreground) launched by booster. The ferries will be designed to carry the long yellow cargo containers within a bay just forward of their engines. In the nose of the Ferry Rocket is the passenger and operating section with a universally mounted spherical guidance compartment. This guidance unit will be fitted with directional radar, an optical telescope, and full astrogational equipment.

The Mars Supply Fleet will complete each assigned mission in one to two Earth years, depending on whether or not the Solar Ships are equipped with auxiliary boosters for extra initial speed.

ARMA, now providing all-inertial guidance systems for later models of the Air Force ATLAS ICBM, is in the vanguard of the race to outer space. At ***ARMA***, privately funded research programs in space technology are studying super-sensitive inertial devices for navigation and satellite instrumentation. For this effort, ***ARMA*** seeks scientists and engineers experienced in astronautics. ***ARMA***, Garden City, New York. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH ARMA CORPORATION

IATA May Ease Ban on Manufacturers

Final decision on whether manufacturers can attend future IATA meetings rests with executive committee.

By L. L. Doty

Copenhagen—Chances that the current ban on manufacturers at the International Air Transport Assn. general meetings will be at least partially lifted now appear strong as a result of protests against the restriction by 22 carriers during the closing session of the sixteenth annual general meeting here.

Although carriers casting a vote in favor of an easing of the current prohibition against manufacturer attendance did not represent a majority because of a number of abstensions, they outnumbered the active opposition which was able to muster but 19 votes in favor of restriction. Final decision now rests with the executive committee of IATA which originally declared Copenhagen off-limits to the manufacturers during the IATA meeting (AW Sept. 19, p. 40).

It was generally conceded here that a large majority of the executive committee backs a continuance of the ban at all future general meetings on grounds that activities of the manufacturers distract delegates from regular IATA business. Airlines opposing this stand, generally those headquartered in remote areas of the world, claim IATA general meetings give them their only opportunity to meet with manufacturers and discuss operating and maintenance problems and new equipment projects.

Easy Range

Since most airlines represented on the executive committee are located within easy range of manufacturers or their district offices, the importance of direct communications with manufacturers at IATA meetings was not an issue when the executive committee invoked the ban immediately following last year's general meeting in Tokyo. In Tokyo, manufacturers were allowed to offer their normal social events but were barred from IATA social activities.

Total ban was put into effect late last year with a letter from IATA's director general, Sir William Hildred, to all manufacturers which established IATA activities in Copenhagen out of bounds to all manufacturers. All but one manufacturer, Sud Aviation, which had one representative on hand during this year's meeting, complied with the decision.

Despite a general feeling among executive committee members that the restriction proved to be a satisfactory arrangement here it now appears likely that the committee will bow to the wishes of the 22 dissident airlines in a compromise move that will undoubtedly embrace some stiff ground rules as to the degree of manufacturer participation at ensuing IATA meetings.

In addition, the action may help to relieve some of the pressure or dissatisfaction against the executive committee that emerged during the general meeting here. A number of delegates representing smaller airlines expressed the feeling to Aviation Week that the executive committee appeared to exert its full executive powers on issues of immediate interest to its members while relaxing on other matters considered of equal importance by the small carriers.

For example, the committee forcefully swept aside protests raised on the assembly floor against the resignation of the IATA traffic director, John Brancker, but allowed demands for stronger enforcement procedures to lapse into inaction because of widely scattered views on the subject. One delegate told the assembly during the closing plenary session that unless enforcement proceedings were tightened and rigidly pursued his carrier could see no need to remain a member of IATA. Another delegate told Aviation Week that failure to act on a stiffening of enforcement requirements could prolong the Traffic Conference, which began in Cannes last week, another full week.

On this subject V. H. L. Dubourcq of KLM and chairman of this year's Traffic Conference called for more compromise and closer cooperation as a means of maintaining IATA unity. He charged that political considerations often prevent solutions to purely commercial problems in the conference and cited the failure of two carriers to reach accord on South Pacific rates and fares because of a fear that inter-governmental bilateral discussions would be prejudiced by a conference agreement.

Small Differences

Dubourcq said inability to settle on rates in the Central and North Pacific areas stemmed from differences on matters of small importance and added:

"In essence, it seemed that the inability to agree on fares . . . hinged on differences of opinion as to inches of seating pitch and $10 on the fares."

He warned that voting procedures in the conference may be subjected to "drastic alterations" unless more give and less take are injected into future conferences. He told the assembly that current voting procedures were designed to prevent small carriers from suffering from inter-conference agreements which might be harmful to them but that such procedures "were not designed to permit small carriers to interfere with agreements which did not in fact affect their operations to the slightest degree." He added:

"If inter-conference fares are to be voted down by local carriers which have no interest in the routes, then reaching agreement will be impossible."

In this connection, Dubourcq hit on the very issue which created the small rebellion within the annual general meeting this year: the drive by small carriers to win more power at this time. It is unlikely they will willingly relinquish the one device remaining to give them a voice in IATA matters: the right of veto in traffic conferences.

Seaboard & Western Airlines, which

New TWA Chief

New York—Trans World Airlines' board of directors last week was expected to approve the appointment of Fred M. Glass as president of the airline to succeed Charles S. Thomas.

Thomas recently resigned from the TWA post (AW Aug. 1, p. 29), which he took in July 1958.

Glass, senior vice president and vice chairman of the board of the Empire State Building Corp., has a wide background in aviation. He was director of aviation for the Port of New York Authority from 1949 to 1955. He was president of Air Cargo, Inc., 1947-49; a vice president of Capital Airlines, 1946-47; chief of staff, Pacific Division, Air Transport Command during World War II; American Airlines attorney, 1939-42; and chief attorney-examiner, air safety board of Civil Aeronautics Board, 1938-39.

always has been a strong dissenting force in the IATA Traffic Conferences, lost its voting strength within the conference, at least for the moment, when it was decided to separate cargo and passenger rates in voting procedures. Other small carriers openly expressed suspicions that voting techniques may be revised to abrogate their voting rights on over-all fare structures which, they claim, have a direct bearing on the construction of local rates.

Conference voting procedures have, in fact, been under study for some time by the Traffic Advisory Committee but the group has been unable to offer any revised systems because of the sharp split between regional operators and large international carriers. Nevertheless, changes of some sort in conference operating procedures can be expected if the Cannes meeting is bogged down by failure to reach agreement on major issues.

"If you want the Traffic Conferences to be completed in the time allocated, and if you want to avoid criticism of Traffic Conference procedures, then your representatives must be instructed to reach agreements quickly and not to hold out until the last possible moment. If you want to avoid a last minute breakdown, then your senior representatives must stay until the job has been completed, and then should exercise restraint in the use of their voting rights."

Several procedures, proposed as alternatives to a revision of voting procedures as a means of preventing deadlocks in conferences, have been under study by the IATA Traffic Advisory Committee. One suggestion calls for the automatic extension of existing fares beyond the one year expiration date until such time as agreement can be reached in emergency sessions.

This plan has been rejected on grounds that some governments refuse to approve rates and fares for a period of more than one year. Furthermore, the committee felt that the proposed system might encourage some carriers to take a "negative position" on fare changes if they felt that the status quo would be retained by simply disagreeing with any new suggestion which was offered.

In its report to the assembly, the Traffic Advisory Committee warned against government interference in rate adjustment. Admitting that individual governments hold the right to approve or disapprove conference resolutions, the committee charged that some governments have in the past made alterations which have caused difficulties.

The report then noted:

". . . There does seem to be a tendency on the part of some carrier members to secure by means of government action things which they failed to obtain through conference machinery. On some occasions, government reservations have been intended to give individual carriers competitive advantages which were certainly not intended by the conferences."

In this connection, the committee reported that it has not been entirely clear as to whether all South American governments are ready to take steps to ensure a stable rate situation in that area. The committee found that some non-IATA carriers are adhering to IATA standards in South America but that the "situation there is not wholly satisfactory."

Engineer Training Rules Due Jan. 1

Washington — Federal Aviation Agency completed hearings on proposed regulations designed to improve airline training programs for flight engineers last week, and the agency plans to adopt new standards by Jan. 1.

General support for the FAA proposal was expressed by the Flight Engineers International Assn., while the Air Line Pilots Assn. raised several objections. Air Transport Assn., offered no comment on the grounds that the points being discussed were thoroughly explored earlier in a meeting between airline managements and FAA Administrator Elwood R. Quesada.

Robert A. Burbick, head of FAA's Maintenance Airmen and Schools Section, estimated that the proposal in final form would be adopted by Jan. 1, and he indicated that hearings covering FAA approval of independent flight engineer schools will be held in the near future.

In their present form, FAA's training program proposals are flexible to meet the individual operations and needs of the airlines. Details of each airline's training courses, including instructors available and hours of ground and in-flight instruction being offered, would have to be submitted for FAA approval.

Basically, the proposed FAA standards require minimum initial ground school training of 120 hr. for piston-engine aircraft and 150 hr. for turbojet instruction. Flight instruction rules require a minimum of 30 hr., with flight simulator time permitted to count on an equal time basis toward the minimum. Approximately 5% of the total ground school time is to be devoted to a study of applicable Civil Air Regulations and company procedures, 15% to aircraft performance and limitations and the remaining 80% to aircraft structures, powerplants and systems.

Recurrent ground training, conducted periodically to maintain proficiency, would cover the same scope, with a 50% emphasis on knowledge of any aircraft or powerplant modifications needed to keep the engineer up to date, FAA said. Simulator training should provide 30% of the instruction for normal operating procedures and the balance for emergency procedures, with an emphasis on crew coordination.

Approval of the individual programs will be based on a personal inspection and acceptance of the courses and facilities being provided, FAA said, with cancellation of the program wherever it fails to meet the FAA standards. Carriers which fail to retain all of the standards set by FAA will have a seven day period in which to correct the situation or face cancellation of their programs.

Training Time

FEIA favors a minimum ground training time of 180 hr. for turbine aircraft based upon factory and airline programs, which it maintains have proved adequate. The union also wants a basic prerequisite of a three-week basic electronics course provided by the airline as a means of better acquainting the flight engineer with the alternating current electrical power systems used on turbine equipment.

Air Line Pilots Assn. took the stand that pilots should receive equal training in flight engineer duties from the carriers. ALPA also urged that preflight and maintenance checks customarily performed by the flight engineer be conducted under the direct supervision of the pilot in command. In addition, ALPA told FAA that the airlines should have the responsibility of defining the duties of flight engineers, while the actual performance of the duties should be assigned at the discretion of the pilot.

GSA Asks Suspension Of Higher Coach Fares

Washington—General Services Administration has asked the Civil Aeronautics Board to suspend and investigate proposals of five major trunk airlines to increase certain long haul turbojet coach fares.

GSA charges the increased fares (AW Sept. 19, p. 47) would be "substantial, unjustified and unreasonable" because higher coach fares will affect that part of the traveling public which desires fast, low cost air travel. GSA said higher fares would serve to "lower the already low load factors of the carriers."

Earlier this month, American Airlines, Continental Air Lines, Northwest Airlines, Trans World Airlines and United Air Lines filed with the Board for jet coach fare increases.

Probe of United-Capital Routes Urged

Washington—Competitors of Capital Airlines are pressing the Civil Aeronautics Board to launch a broad investigation of the carrier's route structure which could effectively block its planned merger with United Air Lines.

Rejected by Examiner Thomas Wrenn during a prehearing conference on the merger plan, motions filed directly to the Board by Delta, National, Eastern and Northwest Airlines seek to either condition any merger approval on a suspension and transfer of most of Capital's routes, or include a full-scale investigation of the airline's route structure in the merger case.

Pointing out that CAB fully intends to adhere to an expedited schedule in the case, which the two airlines want decided by Feb. 1, 1961, Board members told AVIATION WEEK they expect to rule upon the motions in the "very near" future. Timetable for the case will require an examiner's hearing on Oct. 19.

Boards of directors of both carriers already have approved the merger agreement, which will be presented to their stockholders Oct. 14.

Vickers Armstrongs Co., Ltd., which began foreclosure action against Capital last April for non-payment of $33.8 million on Viscount aircraft, re-emphasized the importance of the Feb. 1 deadline and warned that if a CAB decision is not made by that date the company intends to press its foreclosure suit.

Terms of the merger agreement will repay Vickers considerably less than the debt owed, but were accepted on the basis of equipment liens and the value of Capital's routes, the manufacturer said.

Vickers' Position

"At this time," said Vickers, "competitors should not be allowed to strip Capital of any asset which permits it and its debts to be salvaged. If the Board permits this attack on an airline in distress, it would set a precedent that will warn the financial community not to extend credit to any airline unless fully covered by securities."

Basic argument submitted by Delta is that any Board approval of the planned merger should limit the competitive size and effect of the merger company by suspending Capital's Route 51, a major north-south route from Buffalo to Florida. Delta wants the major cities of New York, Washington, Buffalo, Miami, New Orleans and Memphis added to its system either by CAB transfer or direct sale.

Grounds for the motion, the airline said, can be found in CAB statements answering a request by National Airlines that Northeast authority between New York and Miami be canceled.

In an order rejecting this motion, Board members noted that should Trans World Airlines and Northeast sign a merger agreement, any consideration of renewing Northeast's authority in the Florida market would probably be consolidated in a CAB case considering this merger.

Eastern told the Board that it was not concerned over either the size of competition of any combined Capital-United merger, but it believes that permitting Capital to retain Route 51 would amount to a duplication of services and asked that the Board investigate this point as part of the merger proceedings.

Northwest called for the Board to reinstitute an investigation of the Capital system which CAB dismissed last May after Capital withdrew an application for subsidy.

Local Airlines Apply

In other motions, both Allegheny Airlines and Mohawk Airlines asked that their current requests for many Capital points be included in the current merger case.

Capital and United filed a joint objection to these motions, pointing out that United considers Route 51 vital to the proposed merger and will not complete any agreement without the Capital points. Approving the motions would delay the proceedings and amount to "remaking the entire airline route system east of the Mississippi," they said.

In addition, the two airlines contend that there is far more precedence for rejecting the motions than granting them. They noted that the Board dismissed similar motions by Delta, in the rejected Northwest-Capital merger and by United in the Braniff-Mid-Continent merger approved eight years ago. In each case, they said, the Board based its denial of motions on grounds that they would unduly enlarge, delay and complicate the merger agreements under consideration.

Bureau counsel of the CAB said that it favors an investigation of Capital's route system as part of the merger case because of the size of the combined carrier, which would have assets and operating revenues 15% greater than those of American Airlines, currently the largest trunkline. Citing the competitive impact the merger could create, Board attorneys estimated the merged company would have revenues and assets four times those of Delta and Northwest and six times those of National.

While recognizing that granting the motions will require a new pre-hearing conference and other delaying procedures, bureau counsel said that there was reason to doubt that failure of the Board to meet the Feb. 1 deadline would result in Capital and United dropping their merger plans or in Vickers foreclosing on Capital.

New Ft. Worth Service Ordered

Washington—New American Airlines service with turbine-powered equipment has been ordered between Ft. Worth and New York and Washington in a Civil Aeronautics Board decision which specified the type of aircraft to be used and ordered the service without a formal hearing.

CAB reopened the Ft. Worth Adequacy of Service Investigation, which was decided Sept. 24, 1958, with a ruling that American and Braniff Airways were providing ample service between the Texas city and New York and Washington, and decided service should now be improved. Airline requests for a full formal hearing were denied.

The Board ordered American to schedule one daily turbojet flight between Ft. Worth and New York and a daily turboprop flight between Ft. Worth and Washington. CAB said that "American can readily meet the minimum needs of Ft. Worth . . . by shifting one Boeing 707 and one Electra flight from Love [Dallas] to Carter Field [Ft. Worth]."

These two positions are viewed here as departures from usual CAB practice. Airlines argue that the Board, by "retaining jurisdiction," can reopen an adequacy of service case at will and order schedule changes that represent "ruinous intrusions upon the industry."

American's Position

American contends that the whole record of a once-tried case must be brought up to date by formal hearing before additional service legally can be directed by the Board. For this reason, the airline will petition for CAB reconsideration of the Ft. Worth decision. If this is denied, American will challenge the decision in court.

CAB, on the other hand, explains that a "grave injustice to the City of Ft. Worth" would result if a second, time-consuming hearing were held before relief was afforded. Jurisdiction

deliberately was retained, the Board points out in its opinion, so that a remedy would be ready in the event air service "deteriorated."

In appeal, American is not expected to contest the Board's naming of particular aircraft types, even though the Ft. Worth case marks the first time CAB has specified plane types, frequency of flights, en route stops and the time span (one year) over which service must be provided in a single package.

Common Market

Legal strictures against specifying aircraft types in adequacy of service cases do not apply when a common market containing two rival cities is involved, a CAB official told AVIATION WEEK. If Ft. Worth's ability to support a daily flight to the East Coast is to be tested, the service must be at least equal to that offered 35 mi. away at Dallas, he said.

This reasoning apparently was responsible for the Board's highly specific ruling, which went beyond bureau counsel's recommendation that American and Braniff provide four round trips weekly from Ft. Worth to Washington and to New York in four-engine, pressurized aircraft.

The CAB decision called attention to the service from Ft. Worth to the East Coast that was furnished last March by the two carriers. This effectively was limited to American's single one-stop DC-6 flight to New York and American's one two-stop DC-6 flight to Washington.

Dallas, by contrast, had four daily nonstop jet trips to New York and four daily Washington nonstops.

"While American may find it more profitable to serve the Ft. Worth public through Dallas," the Board said, "it does not follow that the carrier has unlimited freedom to do so." It went on to say that because the Dallas-Ft. Worth area never has been certificated as a single trunkline point, a carrier is not "free by indirection to decertificate Ft. Worth."

One Board member, G. Joseph Minetti, filed a concurring opinion in the case, arguing that Braniff should either provide single-plane Ft. Worth to Washington/New York service or relinquish its certificate to serve the routes.

CAB majority, however, considered that Braniff's earlier attempts to compete with American had failed and that the carrier should not be forced to resume service.

Landis Wins Round in ALPA Fight

New York—Eastern Air Lines Council 51 of the Air Line Pilots Assn. voted 179 to 66 last week to support James M. Landis, former chairman of the Civil Aeronautics Board, in his campaign to wrest ALPA's presidency from Clarence N. Sayen.

Automatically seated on ALPA's 300-man board of directors, Council 51's chairman and senior copilot representative now will work to waive association bylaws, thus enabling Landis, who is not an airline pilot, to run for office. To secure the waiver, 200 votes will be required.

In his first public test of strength with Sayen, Landis drew strong support from junior captains and most copilots in Council 51. Hard core opposition centered in a group of senior captains, many of whom had worked closely with Sayen during his nine-year tenure as ALPA president.

Should this split be repeated in other council votes, Landis' chance of unseating Sayen probably will depend on the electoral interest generated within ALPA's copilot ranks. In several key respects, however, Council 51 and Council 51's vote may not be typical of over-all ALPA sentiment.

Council 51 chairman Jack Young, for example, has been in the vanguard of the Landis-for-president movement since its inception last summer. Council 51, moreover, was active in last June's wildcat walkout against Eastern over displacement of the third jet pilot by Federal Aviation Agency inspectors.

Handling of this dispute by ALPA headquarters helped form Council 51's decision to retain a full-time public relations consultant of its own. Shortly thereafter, Eastern pilots in New York were further angered when Sayen refused their invitation to explain current ALPA issues in person.

Sayen generally has declined "to engage in political activity," but Landis has scheduled pilot talks at airline domiciles across the country in an active quest for nomination. On Sept. 28, 29 and 30, he plans to hold a series of conferences with ALPA members in Seattle, San Francisco and Los Angeles, then visit Dallas on Oct. 1 and Miami on Oct. 12.

If elected, Landis promises decentralized authority and expert professional assistance in labor-management negotiations (AW Sept. 12, p. 43). Now senior partner in a New York law firm, Landis would operate from Washington, rather than from the ALPA building near Midway Airport in Chicago, and he would relinquish his law practice entirely.

In private conversation with pilots here, Landis has made it clear that he would expect a salary of $45,000 to $55,000 a year if elected, or a wage "reasonably commensurate" with his present income. Sayen draws about $35,000 a year plus expenses.

As of late last week, the Landis campaign still lacked a leadership focal point, but Landis-for-president committees were at work in New York, Miami and on the West Coast.

FAA Seeking Control Over Tall Structures

Washington—Federal Aviation Agency last week proposed a rule under which it would control the construction or alteration of all structures affecting the safety of aircraft in flight.

A host of regulations and policy statements now govern construction of tall structures, among them Parts 609, 610 and 625 of the Regulations of the Administrator, FAA TSO N18, the Joint Industry/Government Tall Structures Committee Final Report and Part 17 of the regulations of Federal Communications Commission.

Permits to build broadcast towers now are issued by FCC, which judges the structures' adequacy as antenna-transmitters but not as flight obstructions. On this point, FCC has followed the recommendations of the Air Coordinating Committee. But by executive order of the President, this committee will cease to exist on Oct. 10.

In its proposal, FAA is attempting to clarify and condense these construction criteria and to acquire centralized control. Specifically, it would:

- **Require persons intending** to build or alter structures of a specified height to notify the FAA.
- **Define mathematically** those structures that could be hazards to flight.
- **Establish a procedure** under which waivers might be granted on an individual basis.
- **Specify procedural rules** for the holding of formal hearings to determine whether waivers or exemptions should be granted.
- **Recognize the particular** requirements of the broadcast industry by setting up "antenna farm areas" with specific vertical and horizontal dimensions within which structures automatically would be excluded from the hazard category.

If FAA acquires authority over tall structures, broadcast towers outside of farm areas probably will require permits from both FAA and FCC.

Erection or alteration of any structure more than 150 ft. in height would require notice under FAA's proposed rule. In addition, any structure within 15,000 ft. of an airport with a height greater than 1 ft. for each 100 ft. of distance from the airport boundary would require FAA approval.

Aviation Insurance Monopoly Charged

By Katherine Johnsen

Washington—A Senate judiciary subcommittee and Justice Department's Antitrust Division have charged the aviation insurance industry with monopolistic practices aimed at maintaining high rates for airlines and other aviation policy holders.

The subcommittee, headed by Sen. Joseph C. O'Mahoney (D.-Wyo.), presented its charges in a 50-page report citing evidence of collusion between the two U. S. aviation insurance pools—United States Aviation Insurance Group, representing 62 insurance firms, and Associated Aviation Underwriters, representing 40 firms—and between the U. S. insurance and foreign aviation insurance groups.

The antitrust division has presented its case, including the findings of the O'Mahoney subcommittee, to a New York grand jury, called in January and still convened.

Aviation hull and passenger casualty insurance rates took a downward turn in the mid-1940s, following investigations of the insurance industry by the Civil Aeronautics Board and the Air Transport Assn. and a threat by ATA to organize its own insurance group.

Factors Boosting Rates

Since 1958, rates have turned upward, at least partially due to the entrance of expensive, high capacity jets into airline fleets. Insurance representatives emphasized in testimony to the subcommittee that one crash "could very easily amount to a $10 million loss and probably greater."

ATA member airlines paid $42.8 million for hull and passenger insurance in 1959, compared with $24.6 million in 1958. The total for hull insurance rose from $16.7 million to $30 million in the same period. For passenger casualty insurance, the total went from $7.9 million to $12.8 million.

The O'Mahoney report partially attributes the rate upturn to the elimination of domestic competition and to an international jet insurance pricing agreement in 1958.

One factor cited in the report was liquidation of Aero Associates, a third aviation insurance pool which had represented four insurance firms. Aero, which had engaged in price under-cutting, was purchased by Zurich Insurance Co. and became a member of the U. S. Aviation Insurance Group (USAIG) in 1958. According to the report, this "drastically reduced" competition in the aviation insurance field.

As evidence that USAIG had worked to squeeze Aero out of the field, the report cited the testimony of USAIG president, A. J. Smith:

"We were very anxious . . . to acquire additional capacity, which we are certainly going to need with the jets in operation. . . . As far as eliminating a source of competition, we, and the entire aviation insurance market worldwide welcome this situation. We make no bones about it. We were glad to get them [Aero] out of our hair and out of the business because they had always been a demoralizing factor."

The subcommittee report cited conflicting testimony as to the financial stability of Aero at the time of its elimination. According to the spokesman for Aero, the pool had operated profitably, although the profits "could not be considered very large." The spokesman for Zurich said the pool had showed underwriting losses for each year from 1954 to 1958.

The subcommittee report noted that the headquarters of the two remaining pools—USAIG and Associated Aviation Underwriters—are located in close proximity in lower Manhattan and claimed that this has facilitated a cooperative, rather than competitive, attitude between the two. It pointed out that there has been "very little shift" in airline accounts and that "it appears that neither of the groups has vigorously sought to wrest customers from the other." With only two pools handling most of the aviation business, the report concluded that "rate competition is virtually eliminated as the two markets tend to become one."

The subcommittee charged the two syndicates with these restrictive rules and policies: "restricting the free entry of applicants into the pools; discouraging the writing of aviation business by members outside of the pools; preventing members from quoting competitive rates outside the syndicates on business which the syndicates do not want or are unable to obtain; discouraging the development of qualified underwriting talent among the member companies who might ultimately compose the nucleus of competing pools; consciously pursuing policies designed to discourage the emergence of additional competing American insurance and re-insurance facilities."

Senate report also cited an informal, but apparently firm, agreement between USAIG and Lloyd's of London on common pricing for insurance on the Boeing 707 jet transport, which was intended to set the worldwide pattern for future pricing of all jet business. The agreement, which became effective in February, 1958, involved a 10% increase in rates.

Lloyd's has remained outside the International Union of Aviation Insurers, the world trade association whose objective is to maintain common rates, according to the subcommittee report. USAIG, a member of the union, subsequently presented the terms of the U. S.-London agreement to the union, which, in turn presented it to its members.

Subcommittee Report

The subcommittee report argues that the fact that the international agreement on uniform jet insurance pricing was not formalized in a contract was only a technicality to avoid possible prosecution of USAIG under U. S. antitrust laws. It cited a statement by Smith to the Union: "In view of such laws, we cannot agree that we will follow the intent of the agreement. Whether we will, in fact, follow it, is another matter. Certainly, I think there is little likelihood of our cutting the London . . . rate under ordinary circumstances and we certainly look upon the agreement as one step that would improve underwriting results in what has been a wildcat market at London."

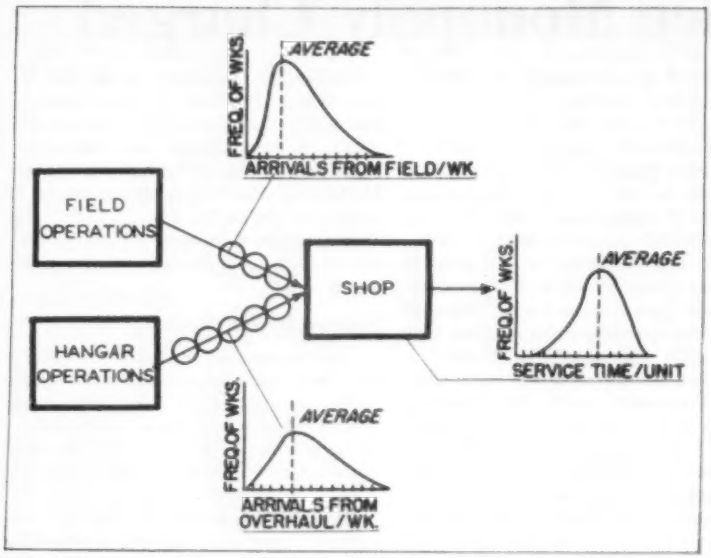
In the field of air travel and air trip insurance, the subcommittee charged that passengers are paying "excessive" premiums and the three companies offering the insurance—Associated Aviation Underwriters, Continental Insurance Co., and Mutual of Omaha—are experiencing "high" profits. The three companies "have been engaged in a struggle for market position, not through lower rates or wider coverage to buyers, but through the payment of enormous rentals to airports."

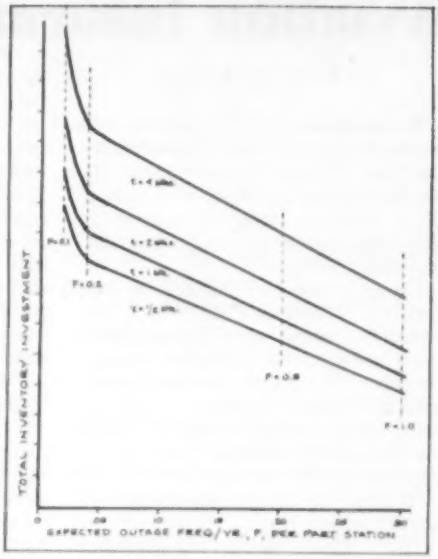
JetStars to Check Airways in 1962

Lockheed C-140 (JetStar) jet utility aircraft will become operational with Military Air Transport Command's airways and air communications services in 1962.

Five C-140s ordered by AACS (AW June 27, p. 50) will initially be delivered by Lockheed Aircraft's Marietta, Ga., Division to AACS' southeastern region at Robins AFB, Macon, Ga. Flight and ground crews will receive C-140 indoctrination at Lockheed and will receive AACS technical instruction at Robins.

The C-140s will periodically visit USAF bases in Europe, Alaska, North Africa and the Pacific in 1963. After these initial visits, one C-140 will be assigned to Europe and one to the Pacific. Others will be based at Robins.





PRODUCTION PROBLEM encountered by an airline when it sets up shop to overhaul thousands of types of prescribed-time rotable components is shown in drawing at left. As shown by top and bottom bell curves, the stream of malfunctioning or out-of-time parts generated by field and hangar operations ebbs and surges en route to overhaul.. Yet in the shop, man hours required to service each rotable vary widely (curve at right). From these two variables, the carrier must produce a systemwide inventory to ensure against aircraft out of commission for parts. Graph at right shows the relationship between an airline's dollar investment in rotable inventory, resupply lead time for a given rotable (t), and the forecast station outage rate (f). As lead time is decreased and probability of outage is increased, total investment decreases. Thus each of the four representative curves maps an infinite number of inventory stock level policies for the carrier.

Computers Reduce Airline Spares Stocks

By David H. Hoffman

Washington—U.S. airlines, worried by the soaring cost of spare parts, are turning to automation in an effort to pare their inventories, which represent investments up to $75 million for the larger carriers.

In increasing numbers, the larger carriers are acquiring electronic computers and basing streamlined parts control systems around them. With material costs threatening to consume more than their present 60% share of airline revenue, the computer trend is accelerating.

Jobs for Computers

Specifically, computers are controlling the flow of repairable components through airline overhaul shops, scheduling the removal of prescribed-time parts on a fleet-wide basis, pinpointing high usage items and monitoring rotable reliability in the field. Reports synthesized by computers from the laws of probability and from data relayed by teletype or transponders inside maintenance shops are keeping managements abreast of the over-all parts situation within their airlines.

An AVIATION WEEK survey of the seven largest U.S. carriers has disclosed that all are either programing or have programed automated inventory control systems and that five now use computers for this purpose. Here is the breakdown:

• **American Airlines** expects delivery of an International Business Machines Corp. 7070 computer in about 18 months. Although the computer initially will be used for financial and operational data processing, American is studying its feasibility as an inventory control instrument. Should this prove impractical, the airline intends to lease a second computer for inventory control.

• **Capital Airlines** now uses a desk-size IBM computer to schedule overhaul of some time-control engine components. In conjunction with IBM, the carrier is experimenting with a punch-card system that ultimately will be used to record time and overhaul due dates for all rotables. A Remington Rand Univac processes reservation and flight data for Capital.

• **Delta Air Lines** controls both production and station stock levels of rotable components with an IBM 650 installed in the carrier's general offices in Atlanta, Ga. Delta's system became operational in February, 1958.

• **Eastern Air Lines** took delivery of an IBM 7070 computed July 11, will assign its passenger revenue accounting Nov. 1. In January, 1961, the 7070, located in Eastern's Miami operations base, will be programed for rotable production and inventory control. The airline also uses a Univac in New York on reservations.

• **Pan American World Airways** began controlling its Overseas Division parts inventory with an IBM computer last June. An IBM 650 in Miami keeps track of rotables and warns of outages in Pan American's Latin American Division. This system became operational in August, 1958.

• **Trans World Airlines** installed an IBM 650 computer in its Kansas City, Mo., overhaul base during June and July. First system-wide inventory reading was furnished by the computer on Sept. 2. TWA schedules overhaul of time-control components with a compact Royal McBee LGP-30 computer.

• **United Air Lines** uses a battery of conventional IBM Electronic Accounting Machines to control the storage and overhaul of rotables, intends to install a more advanced IBM computer with magnetic tape next year. Gradually over the past seven years, computers have been gaining control of scheduling and maintenance functions at United's San Francisco overhaul base.

To illustrate the magnitude of the inventory and overhaul control problems generated by parts, TWA stocks 8,000 different rotables, removes 470

of them from its aircraft on a typical day. At the first of the year, the airline had $49,323,200 tied up in rotables, each of which cost an average $2,000. Daily pipeline value alone was in excess of $1 million.

When furnished a daily tabulation of starters, inverters, hydraulic pumps, generators, etc., positioned along their route structures, major airlines can buy and stock rotables in precise quantities determined by an algebraic equation.

In allocating parts to a given station with maintenance capability, the carrier first determines the number of landings scheduled to take place there during a base time span. By using forecast landings rather than component time since last overhaul, inventory planners link the part with the station at which it is likely to be changed.

This independent coupling of components to traffic at an airport emerges as a mathematical probability of outage when the part's fleetwide failures rate is applied. To improve correlation in the field, some stations are given an empirically deduced additive factor that takes into account the presence or absence of major maintenance capability, the criteria for dispatching aircraft with an inoperative component at the station and local inspection requirements.

Inventory Process

Here is an over-simplified example of the process:

The Lockheed 1049G and 1049H Super Constellations operated by an airline use Part X. Under a new fall schedule drafted by the carrier, 1049Gs will make 10 landings per week on the average at New York International Airport, while 1049Hs will make five. Both aircraft types have an empirically determined weight of four at the airport.

According to the carrier's previous schedule, fleet planes using Part X made 5,200 landings in total. Pre-time removals of Part X during the period were 52. Thus Part X's over-all failure rate was one per 100 landings of .01 per landing.

Forecast Rate

Using these fixed figures as premises, Part X's forecast usage rate at Idlewild is:

- **For the 1049G:** (4) (10) (.01) equals 0.40.
- **For the 1049H:** (4) (5) (.01) equals 0.20.

Thus, total predicted usage at Idlewild is 0.60 units per week.

By applying one more variable—the time it takes to move Part X from its warehouse source to Idlewild—the carrier can pinpoint stock levels that are calculated to ensure not more than one outage in 1 year, 2 years, 5 years, etc.

Repetition of the process for every possible part-station combination would determine total airline inventory. And costing of the parts by type and quantity would determine over-all investment required to guarantee the protection levels selected by the airline's management.

Each sweeping schedule change initiated by an airline calls for a system-wide shuffling of inventories. This holds true whether the change involves flight frequencies, types of equipment, or both. The problem, however, is not so much moving the parts—for the carrier can use its own schedules—as it is determining where and in what quantity the parts should be moved.

TWA reports that 86 million mathematical steps of computation are required to provision properly after one major schedule change. Equaling 10 to 12 man-years of work under old clerical systems, this chore can be accomplished by a high-speed computer in about 3 hr. at a cost to the carrier of $8,000 to $10,000.

Univac, for example, can solve the allocation problem for 75 stations and 5,000 rotables (350,000 part-station combinations) in this time span. Concurrently, the computer can print out information on part failure rates, check consistency and furnish pricing data at a 600 line per minute rate.

With huge sums invested in jets, trunklines are renewing their emphasis on scheduling to boost aircraft utilization. Rapid changes come with increasing frequency. In many cases, spares no longer are positioned at the proper turn-around points. Thus the computer-based control system that can trim inventory costs and, at the same time, increase the supplies available for speedy en route maintenance, takes on critical importance within the industry.

What protection level on-the-shelf components will afford at a particular station is for company to decide. Usually, this decision is reached by balancing various probabilities of outage (once in 1 year, 2 years, 5 years, etc.) with the cost of having and the cost of not having a part at a station.

Cost Considerations

Related mathematically, the probability of outage is weighed against the cost of having an item available divided by the cost of having it plus the cost of not having it. To illustrate, one generator with a known failure rate might be stocked at Station A where a prescribed number of landings will take

TRAIN hauls rotables through storeroom of TWA's overhaul base in Kansas City, Mo. (left). On second dolly is a supercharger, one of 8,000 types of rotables overhauled at prescribed time intervals by the airline. Eastern on July 11 became the first carrier operator of a high-speed IBM 7070 computer (right). Computer will be used initially for passenger revenue accounting in Miami.

place. If an airline computes probability of outage as once every five years, then one generator would be stocked.

With a probability scale ranging from zero to one, this outage rate would be 0.2. If the cost of the generator were $100 and the cost of not having the generator were $200, the cost side of the equation would be .333.—greater than the probability value. This larger figure would warn the carrier that at least one generator must be stocked at Station A to avoid economic penalty.

To the airline, the $200 cost of not having the spare generator available is composed of a mixture of many factors, including the dollar loss when a plane aborts and its passengers must be transferred to a rival carrier's flight, the resulting strain on good will and return business and the cost of furnishing passengers with surface transportation should they elect it.

Computers also play a major role in scheduling an airline's production of rotables. Here the problem is to transform the ebbing and surging streams of faulty components coming from inspection centers and the field into an even supply flow.

Although input varies widely by part by week, output must be constant and correspond with the demand set by computer. Consequently, work crews within the overhaul shops must be shifted from item to item or preplanned stock levels cannot be maintained. Further complicating efficient use of plant and labor force is the fact that each rotable requires its own number of man-hours in overhaul.

Computer Functions

By digesting these variables on a daily basis and by keeping constant track of system-wide inventories, the computer actually informs foremen what they should work on next. The computer also can:

- **Warn of each rotable** approaching its time for overhaul as far in advance as the airline wants to be warned.
- **Monitor the pre-time** failure rate of each component, thus focusing engineers' attention on the need for design changes in certain parts. Because of the time lag built into clerical control systems, rotable types that started to malfunction often were not detected for months.
- **Pinpoint the station** or stations where stock levels have dropped to the danger level.
- **Forecast parts requirements** for a carrier which, when combined with other carrier forecasts, could lead to joint purchasing in certain areas.

At TWA, similar information on expendables (those items that are discarded rather than repaired) is drawn from a computer. TWA expendables, however, are classified under three headings, each of which corresponds to the dollar cost of the items consumed.

Class A includes 6% of the total expendable types used by the carrier but accounts for 85% of total expendable cost to the airline. Class B includes 20% of the items and 12% of the cost, while Class C takes in 74% of the items and only 3% of the cost. Greatest degree of control, obviously, is applied to Class A.

Besides telling TWA how many and what type expendables should be bought, the computer issues staggered alerts on undesirable stock levels. When the computer prints out a "warning level" alert of stock depletion, TWA officials send it to the appropriate vendor.

An emergency signal results in a phone call or personal conference between TWA inventory control officers and the supplier.

Thrust Reversers on P&W Turbofan for Boeing 707-120B

Forward and aft thrust reversers are in operating position (cowling sections slide aft) in this view of the Pratt & Whitney JT3D-1 turbofan engine installed on an American Airlines Boeing 707-120B. Aircraft now has completed 80 hr. of flight testing; the engine is soon to be installed on a Boeing 720B medium range transport. In reversal, turbofan air (cold) is deflected forward by multiple reversing vanes, seen on the forward portion of the engine. Vanes are linked mechanically with the sliding cowling section. Tail pipe cowling slides aft as internal clamshell doors close to divert the exhaust through the exposed cascade vanes. Company said the turbofan does not need a sound suppressor since outside envelope of cold (fan) air helps to mix hot exhaust with ambient air, reducing noise.

LUFTHANSA BOEING 707-420 jet transport is serviced for takeoff at Frankfurt/Main airport, the airline's jet transport base. Lufthansa introduced its first jet services on the North Atlantic route Mar. 17 following delivery of the first of five Boeing 707-420s on order. Two more of the same type went into service on the same route in April and May respectively. By the end of June this year, the West German airline carried out 260 transatlantic flights and logged a total of 2,551 hr. flying time with the Boeings.

Boeing 707s Boost Lufthansa Revenues

By Edith Walford

Cologne, Germany—Lufthansa West German Airlines reports a marked increase in operations so far this year due largely to the recent introduction of its first Boeing 707-420 jet services to North America. The company is hopeful of a steady growth of its share in this market to help substantially in reaching a break-even point financially.

Last year, despite over-all improvement in its share of air traffic, the airline suffered a loss of about $10 million, the biggest deficit since its postwar re-establishment (AW Mar. 28, 1959, p. 46). Even if the present favorable trend can be continued, it will take several years to recover the loss and become fully self-supporting. Aside from a fixed sum written off annually for previous commitments, Lufthansa now has to set aside an additional $2½-million every year for the next few years for the purchase of five Boeing 707-420 jet transports on order.

May Offset Loss

Lufthansa also has hopes of recovering some of its loss when the new cabotage agreement with Scandinavian Airlines System (SAS) is reached. The first postwar agreement between the two countries expired Mar. 31. New negotiations at the government level emphasizing the frequency with which Lufthansa may in the future land in Scandinavia began last December, were discontinued during the summer session and are now scheduled to be resumed early this fall.

With delivery of its first Boeing 707-420 jet airliner in March, Lufthansa inaugurated transatlantic nonstop jet flights to New York Mar. 17. The second and third Boeing jet transports on order were put into service on the same route in April and May respectively. Up to the end of June, Lufthansa carried out a total of 260 transatlantic flights and logged 2,551 hr. flying time with the three Boeing 707-420s alone. In April, the first full month of operation with two aircraft of this type, the airline's average daily utilization rate was 9.91 hr. which by the end of June had been increased to 10.25 hr. daily.

In May, Lufthansa extended the North Atlantic jet service via Montreal to San Francisco and the Pacific. With a traffic increase of 36% on this route alone during the first six months of this year, the West German airline now ranks seventh among a total of 16 competing North Atlantic jet service operators.

In June, Lufthansa carried 104 passengers on every jet flight to North America, thereby increasing the average number of revenue passengers flown per aircraft by about 26%. On the San Francisco round-trip network extension introduced in May, the load factor was stepped up by approximately 60% and Lufthansa has stated that results with flights to Chicago are showing even better results.

Total traffic on Lufthansa's South Atlantic route network increased 61%, the load factor from 44.7% in 1959

Lufthansa Traffic, 1959 vs. 1960 First-Halfs

North Atlantic Route (million ton miles)	Jan. 1 – June 30 1959	1960	Increase
Capacity available	25.9	31.3	21%
Revenue: passenger (ton/mi.)	11.3	16	42%
freight (ton/mi.)	1.78	1.85	4%
mail (ton/mi.)	1.23	1.64	33%
Total revenue (ton/mi.)	14.3	19.5	36%
Load factor	55.2%	62.4%	....
Freight (ton/mi.) available	3.63	7.4	104%
Revenue freight (ton/mi.)	1.16	3.01	159%
Load factor	32.1%	40.8%	....

South Atlantic Route (million ton miles)	Jan. 1 – June 30 1959	1960	Increase
Capacity available	7.05	6.5	.8%
Revenue: passenger (ton/mi.)	2.19	3.84	75%
freight (ton/mi.)	0.61	0.82	33%
mail (ton/mi.)	0.41	0.48	17%
Total revenue (ton/mi.)	3.21	5.14	61%
Load factor	44.7%	77.9%	....

European Network incl. West Germany (million ton miles)	Jan. 1 – June 30 1959	1960	Increase
Capacity available	14.0	22.0	59%
Revenue: passenger (ton/mi.)	5.95	10.5	79%
freight (ton/mi.)	0.41	0.61	50%
mail (ton/mi.)	0.20	0.41	100%
Total revenue (ton/mi.)	6.56	11.52	78%
Load factor	47.1%	52.8%	....
Freight (ton/mi.) available	0.55	0.61	13%
Revenue freight (ton/mi.)	0.27	0.41	50%
Load factor	50%	66.7%	....

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YOUR piston powered passenger carrying aircraft now rendered obsolete by new equipment, and being considered for use in cargo operations, or already actually converted can be completely removed from fleet inventory and written down to zero book value in three years;

ONE THIRD the number of Canadair Forty Fours will carry out your cargo requirements at such a profit that they will absorb all expenses incurred in the retirement transaction, plus any earnings your piston engine aircraft would have realized during these three years;

AFTER THESE THREE YEARS, the Forty Four operating profit curve will climb steeply. The difference in profit potential for the following years is substantial.

Any consideration of a specific example requires certain assumptions regarding scheduling, future rates, and load factors, but, under a representative set of conditions our analysis indicates: —that a fleet of 25 piston powered aircraft currently being converted into cargo carriers, could be replaced and retired by a fleet of 8 Forty Fours. The above assumptions and statements are based on the unlikely premise that cargo rates will remain at present levels. If they are reduced, as seems inevitable, the situation will favor the Forty Four even more strongly.

THE FORTY FOUR. The Canadair Forty Four, with its combination of low direct operating costs, high block speeds and large payload capacity, is the world's most economical cargo aircraft. Delivery schedules can be arranged to introduce the Forty Four into airline service fourteen months from contract agreement.

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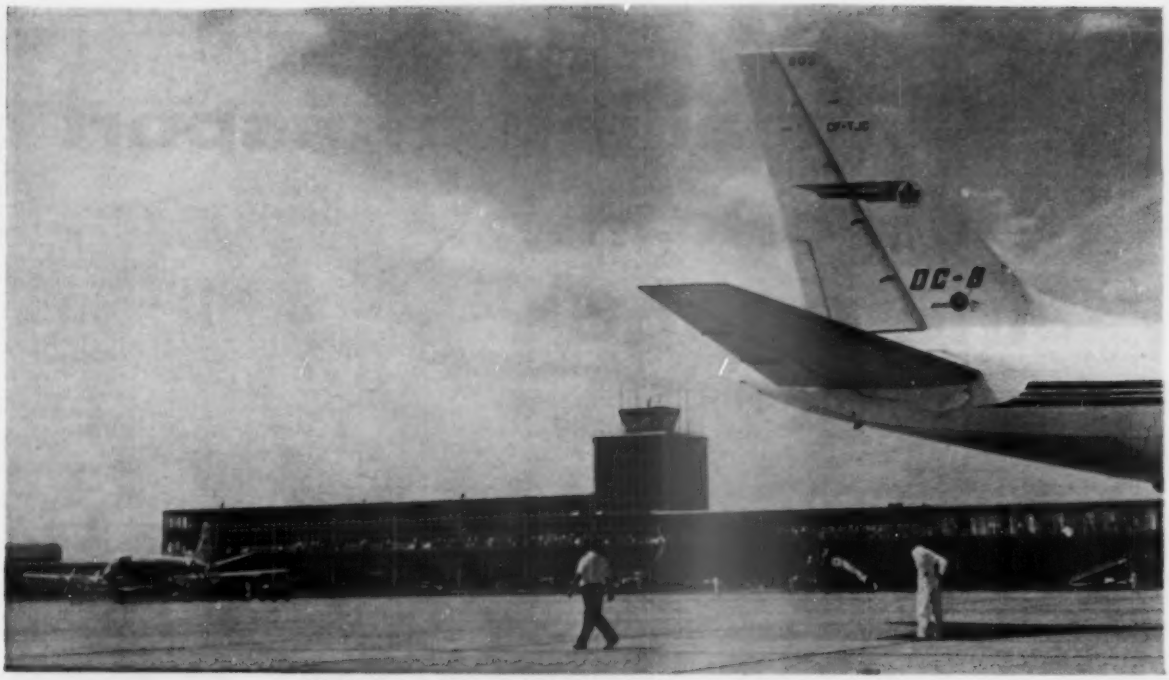


Halifax Opens International Airport

Partially framed by tail section of a Trans-Canada Air Lines Douglas DC-8 jet transport is the 1,260 ft. long terminal building at the new $18 million Halifax International Airport, formally opened earlier this month. Airport has two runways, one 8,800 ft. long and another 7,700 ft. long, and is located about 25 mi. northwest of the Nova Scotia capital city.

to 77.9% during the first six months this year.

Improvements in the frequencies of Lufthansa's European short- and medium-range flights as well as the introduction of more direct flights within West Germany during recent months have also contributed appreciably to the present favorable trend.

Cargo Capacity

With delivery this summer of two of the carrier's four Lockheed Super Constellation 1649A aircraft converted into cargo-only carriers (AW Aug. 1, p. 49), Lufthansa has boosted its freight-carrying capacity on the North Atlantic route by about double its former strength. The two supercargo liners were put into service at the beginning of August on a nonstop Frankfurt/Main-New York run five times weekly both ways.

The airline also reports good results in its charter services, which are becoming increasingly popular. During the first half of this year compared with the same period in 1959, demand rose by 214%.

A comparison of Lufthansa's over-all results for the first half of last and this year shows that capacity has increased from 61 million to 85.6 million ton-miles or by 40% and demand from 29.4 million to 47.2 million ton-miles or by 60%. The load factor during the same period rose from 48% in 1959 to 55% as of June 30 this year.

France May Produce Rolls-Royce Tynes

Paris—Rolls-Royce and France's Hispano-Suiza have arrived at an agreement covering joint production of the Tyne turboprop.

The agreement has been pending for some time. It is expected that Hispano-Suiza's initial role will mainly be assemblage work on the Tyne, using elements supplied by Rolls-Royce. Later, assuming expected demand materializes, the French engine builder will launch a secondary production source for the Tyne.

Agreement between the British and French companies is aimed at meeting the powerplant requirements of two cooperative European programs. One is the joint Franco-German Transall C-160 transport project. The other is the Breguet 1150 Atlantic ASW aircraft being developed to meet a NATO requirement.

Both twin-engine aircraft are expected to use the Tyne. No firm production orders have yet been placed for either aircraft since the prototypes are still being built.

It is expected however, that the two programs will involve between 200-400 aircraft.

The Rolls-Royce license deal with Hispano-Suiza renews past license agreements between the two companies. The French firm earlier built considerable numbers of the Rolls-Royce Nene and Tay turbojets under license. French companies' main engine work at present is concentrated on overhaul contracts, as well as production of SEPR rocket booster engines for the Mirage III. Hispano-Suiza also is engaged in producing landing gear units for the Caravelle and other aircraft.

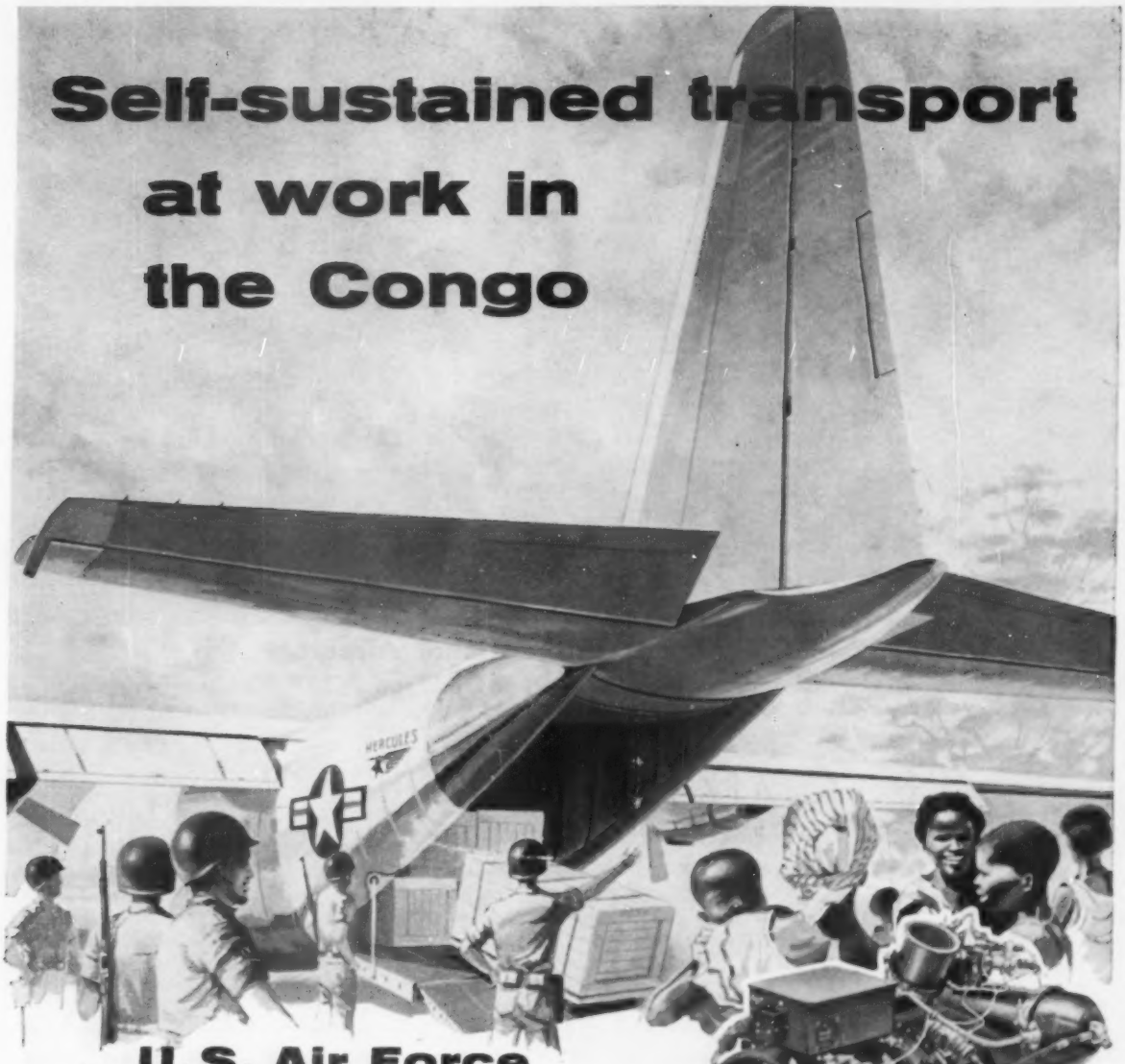
Communist Red Carpet

Moscow—In Russia's classless society, air travelers who take jet transports from Simferopol in the Crimea are now assured of being just a bit classier than their comrades who leave in piston-powered aircraft.

Simferopol has opened a special red carpet section in the air terminal for jet passengers, who also go through a separate gate to their aircraft. On arriving at the Simferopol Airport from Yalta or some other nearby resort by helicopter, jet travelers can get their tickets, check their baggage and be seated in their aircraft "in a matter of three to five minutes," according to the magazine Grazhdanskaya Aviatsiya—all, presumably, without rubbing shoulders with the proletariat.

The Crimea is a favorite vacation retreat for high Soviet officials, and it has frequent nonstop jet service to Moscow.

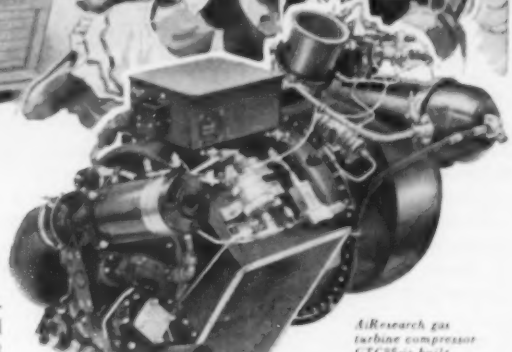
Self-sustained transport at work in the Congo



U.S. Air Force Lockheed C-130 Hercules

The recent crisis in the Congo has once again proved that the self-sustained aircraft is of vital importance in transporting cargo and passengers to and from landing fields where no ground support equipment exists.

The USAF Lockheed C-130 Hercules is designed to land and take off from extremely short runways carrying heavy loads of cargo or passengers. Equipped with an AiResearch gas turbine and starting system, the C-130 is entirely self-sufficient and can operate from the heat of the Congo to the cold of the Antarctic without the need of ground support equipment.



AiResearch gas turbine compressor GTC85-2 built into the left wheel well of the C-130.

AiResearch air turbine starter ATS100 is installed on each of C-130's four turboprop engines.

Please direct inquiries to Phoenix Division.

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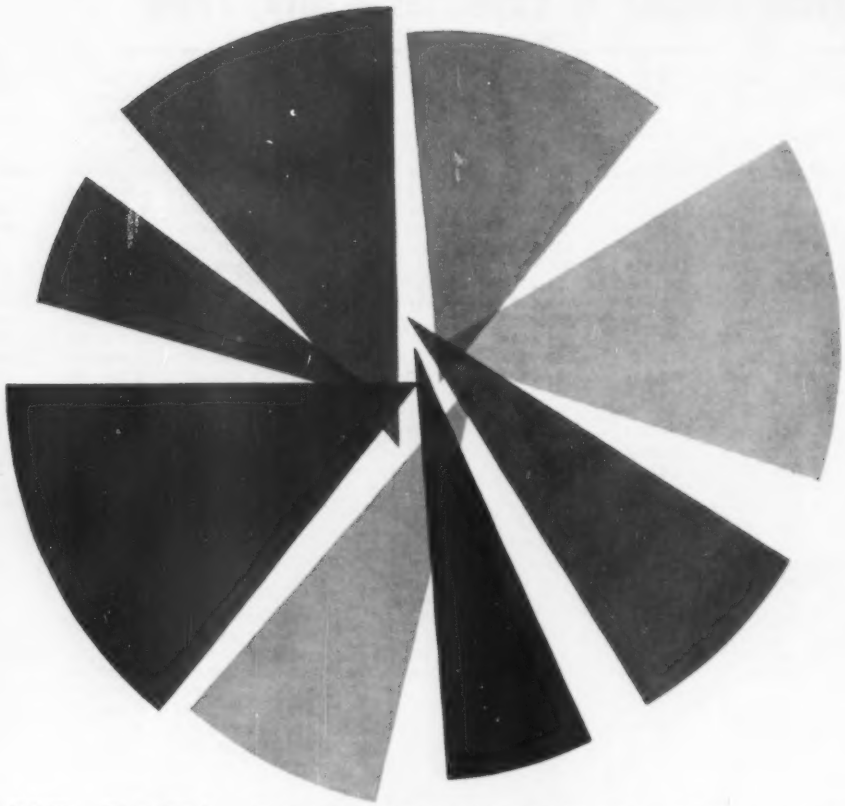
Airline Income & Expenses — July, 1960

(IN DOLLARS)

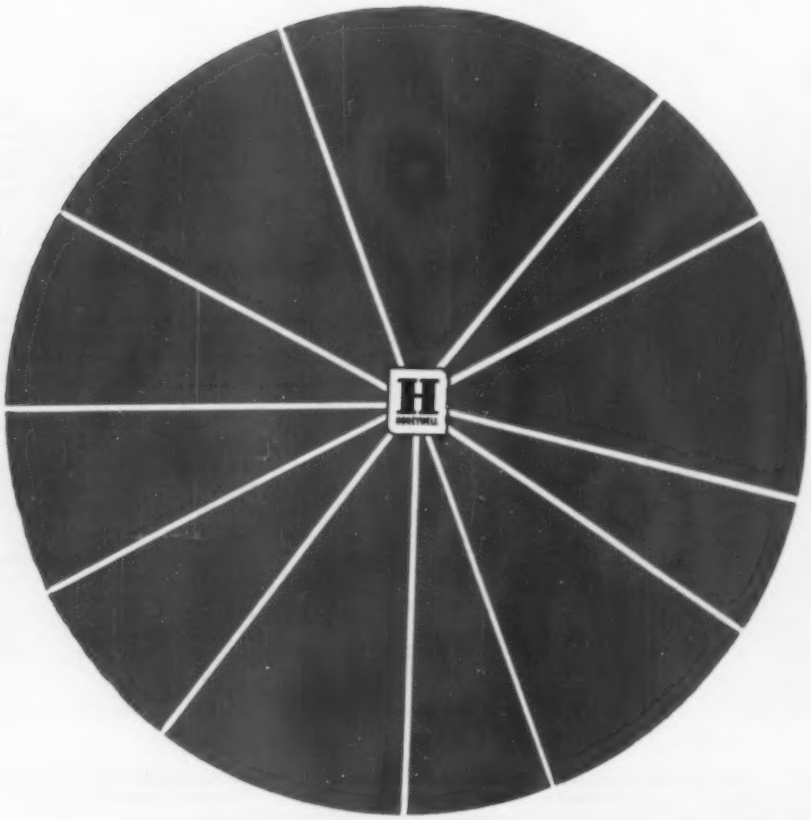
	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	34,604,255	564,875	372,602	1,780,108	.....	37,827,876	34,772,268	3,055,608
Braniff	6,051,020	159,138	70,143	175,174	73,309	6,601,264	6,059,725	418,641
Capital	8,266,415	174,478	137,938	139,468	50,897	8,885,918	9,241,301	−365,383[4]
Continental	5,543,000	82,000	23,000	102,000	21,000	5,878,000	4,931,000	680,000
Delta	9,118,000	165,000	109,000	295,000	47,000[8]	9,907,000	9,705,000	28,000
Eastern	20,352,067	393,726	886,079[5]	.....	6,720	21,828,667	22,907,735	−1,130,968
National	4,353,621	91,765	24,457	161,496	120,858	5,120,732	5,718,914	−244,681
Northeast	3,193,478	42,962	17,149	78,734	.....	3,384,243	3,772,635	−388,390[4]
Northwest	6,721,966	188,316	546,861[5]	.....	7,579	7,499,367	6,534,344	859,322
Trans World	24,233,942	474,248	1,271,001[5]	.....	140,503	26,243,177	24,438,845	1,379,361
United	29,751,065	923,384	1,963,680[5]	.....	235,958	33,036,287	29,820,644	3,485,798
Western	5,686,769	105,956	181,572[5]	.....	66,193	6,053,601	5,397,356	590,385
INTERNATIONAL								
American	554,001	8,824	200	43,547	.....	635,128	562,634	72,494
Braniff	1,005,864	23,683	.....	62,441	.....	1,151,804	1,028,568	103,285
Caribbean Atlantic	326,152	2,415	15,457[5]	.....	1,885	350,780	281,081	70,489
Delta	293,000	4,000	.....	8,000	.....	318,000	442,000	−132,000
Eastern	3,364,208	38,799	125,170[5]	.....	.....	3,531,489	2,845,362	629,983
Mackey	169,139	.....	690	2,624	38,122[8]	182,078	169,192	12,886[4]
National	182,133	1,220	648	1,714	.....	195,734	164,975	30,759
Northwest	2,464,759	520,303	362,720[5]	.....	26,805	3,458,383	3,237,010	152,181
Pan American Combined	33,471,000	1,772,000	.....	3,493,000	601,000	40,494,000	34,904,000	4,789,000
Alaska	556,000	15,000	.....	48,000	.....	631,000	716,000	−84,000
Atlantic	17,121,000	854,000	.....	1,401,000	459,000	20,239,000	16,143,000	4,145,000
Latin America	7,712,000	218,000	.....	1,150,000	73,000	9,654,000	10,106,000	−439,000
Pacific	8,082,000	685,000	.....	894,000	69,000	9,970,000	7,942,000	2,048,000
Panagra	1,309,000	54,000	.....	225,000	7,000	1,759,000	1,802,000	326,000
Resort	.....	.....	.....	.....	8,052[7]	8,052	36,226	−27,299
Trans Caribbean	710,522	.....	54,426[5]	.....	29,992	817,970	636,712	213,405
Trans World	10,856,870	566,129	641,089[5]	.....	589,510	12,718,401	8,705,391	3,941,370
United	2,923,988	67,927	53,590[5]	.....	21,743	3,078,528	1,988,131	1,044,336
Western	347,952	5,461	10,789[5]	.....	.....	365,171	359,864	661
LOCAL SERVICE								
Allegheny	925,197	10,700	18,203	24,253	1,159[8]	1,274,611	1,373,706	−99,095[4]
Bonanza	367,418	3,105	2,593	4,768	32,889	616,626	661,015	−41,481
Central	214,348	7,082	2,371	6,800	213	468,431	480,187	−11,756[4]
Frontier	604,320	13,448	4,285	27,759	14,389	1,215,826	1,133,518	67,508
Lake Central[1]	.....	.....	.....	.....	.....	.....	.....	.....
Mohawk	847,390	11,602	13,707	14,001	32,410	1,098,008	1,162,886	−64,878[4]
North Central	1,198,372	29,400	22,000	23,271	9,308[8]	1,825,944	1,799,842	8,965
Ozark	674,042	15,623	11,414	17,304	8,267	1,053,390	1,066,798	−13,408[4]
Pacific	592,977	18,046	6,313	4,770	47,710	958,904	967,697	−46,886
Piedmont[9]	634,636	9,784	4,998	10,565	25,961[8]	1,024,461	1,034,330	35,350
Southern	110,278	2,631	1,292	2,566	.....	193,645	382,756	189,111[4]
Trans-Texas	451,652	12,642	5,286	16,509	5,479	748,151	719,994	29,471
West Coast	569,808	9,752	4,146	11,495	2,733	922,894	948,889	−25,994[4]
HAWAIIAN LINES								
Aloha	.....	.....	.....	.....	.....	.....	.....	.....
Hawaiian	715,007	3,152	.....	80,459	207,062[8]	1,023,140	976,518	23,253
CARGO LINES								
AAXICO	.....	.....	.....	.....	115,344[7]	115,344	151,845	−36,501
Aerovias Sud Americana	.....	.....	.....	148,137[5]	170,957	319,098	297,428	17,175
Flying Tiger	.....	7,880	1,007,353[5]	.....	1,016,926	2,098,151	2,268,790	−245,320
Riddle	.....	.....	.....	.....	.....	623,577	783,540	−159,964
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	.....	910,907	945,176	830,898	114,278[4]
HELICOPTER LINES								
Chicago Helicopter	171,425	135,898	.....	.....	.....	308,164	288,796	18,236
Los Angeles Airways	26,360	12,779	9,332[6]	.....	.....	261,261	143,441	128,311
New York Airways	100,179	5,768	3,283	3,623	.....	318,505	290,931	22,640
ALASKA LINES								
Alaska Airlines	256,519	53,029	1,719	44,567	230,149	733,559	683,885	38,143
Alaska Coastal	129,352	8,583	.....	13,103	6,973	389,071	200,599	88,422
Cordova	21,585	7,787	.....	10,619	40,952	112,397	108,052	2,488
Ellis	89,155	5,283	9,100[5]	.....	826	136,354	123,071	13,283[4]
Northern Consolidated	126,876	38,306	.....	34,601	25,363[8]	292,841	265,618	27,223[4]
Pacific Northern	864,127	67,922	2,378	103,511	2,029	1,194,902	1,023,180	164,836
Reeve Aleutian[1]	.....	.....	.....	.....	.....	.....	.....	.....
Western Alaska[1]	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	201,542	62,781	.....	48,895	73,767	546,718	470,070	42,648[4]
Avalon Air Transport[1]	.....	.....	.....	.....	.....	.....	.....	.....

[1] Not available. [2] Property figure. [3] Non-scheduled transportation or other transportation. [4] Net operating profit or loss. [5] Common carriage. [6] Express & excess baggage. [7] Non transport revenues—no operations in July. [8] Freight & excess baggage. [9] Airline Division figures.

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.



YOUR DATA SYSTEM–HYBRID OR HONEYWELL?



The answer can be important to you. True, you can combine several makes of instruments into a system and get adequate results. But you usually pay a penalty for hybrid systems. There's the burden of responsibility for engineering and maintaining the system. There's the question of whether it will do what you want it to. There's the problem of modifying various makes of components to work together. And there's the inconvenience of buying instruments and spare parts from several suppliers instead of one.

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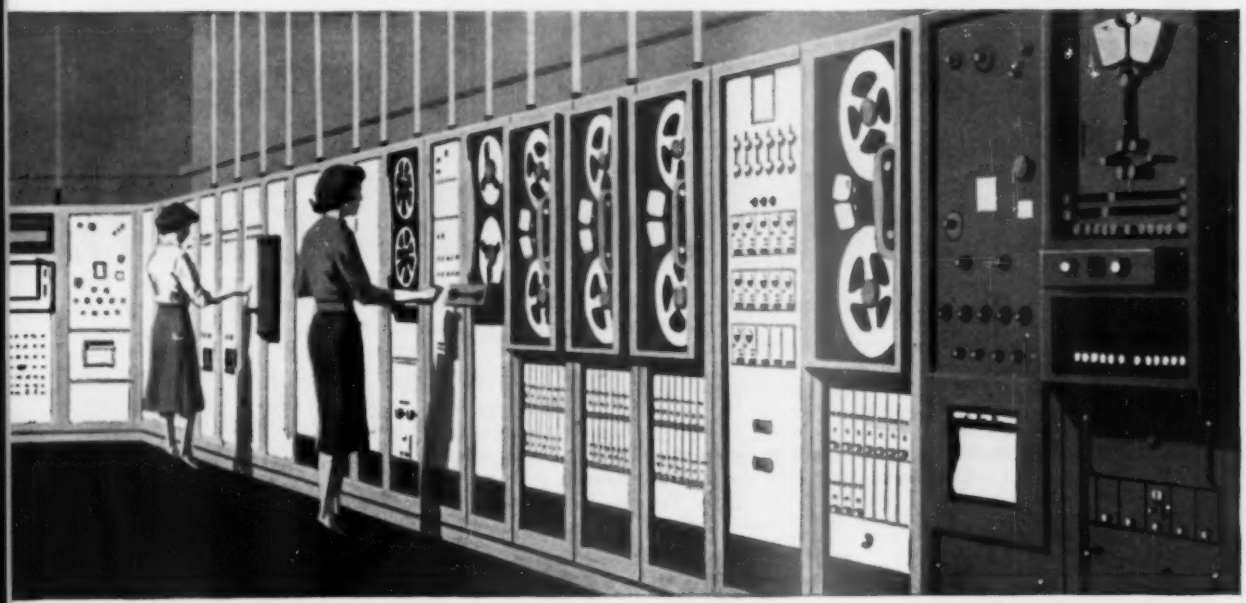


AIRLINE OBSERVER

▶ Rift between the Air Line Pilots Assn. and the Air Line Stewards and Stewardesses Assn. has spawned a new stewardess union, the International Guild of Flight Attendants. IGFA says in its organizational pamphlets that, while it has been encouraged by several large international unions, it is independent and not affiliated with any of them. The new union said it got organizational advice from Transport Workers Union, United Auto Workers, International Assn. of Machinists and International Brotherhood of Teamsters.

▶ Federal Aviation Agency's regulatory powers may get a thorough overhauling next year if Sen. John Kennedy (D.-Mass.) is elected President. Air Line Pilots Assn. and other groups which have objected to Administrator Elwood R. Quesada's authority received tentative support from Kennedy last week for a move to limit this power. In a letter to ALPA, Sen. Kennedy indicated he would support the reintroduction of legislation by Sen. Clair Engle (D.-Calif.) granting the Civil Aeronautics Board the authority to review any FAA regulations which the Board considers not in the public interest.

▶ Lucius C. Burton, acting director of National Capital Airports for the Federal Aviation Agency, will be replaced by Ward Hobbs, former Capital Airlines vice president who also has 25 years experience with American Airlines. Hobb's appointment is awaiting the return of FAA Administrator Elwood Quesada from a tour of the Soviet Union. Burton has been named director of aviation for Ft. Worth, Tex.

▶ Air Line Pilots Assn. negotiations with many local service airlines may face a tougher management attitude as a result of the stand taken by Southern Airways, which has succeeded in restoring a high percentage of service despite a nearly four-month-long pilot strike. Availability of unemployed pilots to maintain operations, plus ALPA's inability to call a threatened sympathy strike by pilots on other airlines, is increasing management optimism. Likely trouble areas in future pilot-management talks would probably be concentrated in the predominantly anti-union South.

▶ Domestic trunkline traffic totaling 19.8 billion revenue passenger miles in the past eight months produced a 6.2% gain over the same period last year, despite a 4.5 point drop in load factor during August. Carriers reached a 61.91 load factor this August, compared with 66.4% for the same month in 1959. Coach service accounted for 54.5% of the August revenue passenger miles, compared with 48.1% in August, 1959.

▶ Export-Import Bank has approved loans totaling $20 million to Air India and South African Airways for the purchase of Boeing 707 turbojet transports. SAA is buying three 707s at a total cost of $26 million on an Eximbank loan of $16 million. Air India is buying one turbojet on an Eximbank loan of $4.1 million.

▶ Air France has sold six of its Lockheed L749A Constellations to the French air force for use as aeronautical research and search aircraft. The aircraft have been modified for the government by the airline.

▶ Northeast Airlines' Boeing 707 daily round trip between Miami and New York generated more than $2.5 million in gross revenues to partially offset the carrier's DC-6B losses over the same route during the first half of 1960. The single turbojet aircraft earned about $1 million more in this period than Northeast's 11 DC-3s, even though the piston-engine aircraft logged 16 times as many scheduled hours.

▶ Trans World Airlines estimates that it will be overhauling Pratt & Whitney JT3 engines at the rate of one a day within the next two months at its Kansas City maintenance base. Overhaul work on the Boeing 707 powerplants was formerly done at Southington, Conn., under a contract with P&W.

▶ Eastern Air Lines is continuing to shift sales emphasis from flight frequencies to improved customer services. Latest programs concentrate upon earning public recognition for schedule reliability and improving in-flight food services.

SHORTLINES

▶ **Braniff Airways** and Gibson Refrigerator Division, Hupp Corp., have signed a contract under which Braniff will fly 7,000 to 9,000 Gibson appliance dealers to the company's 1961 convention at Panama City. Braniff will use its Boeing 707-227 turbojet airliners to make more than 50 flights from 21 U.S. cities. Pan American World Airways flew this year's convention delegates to Hawaii (AW Sept. 12, p. 51).

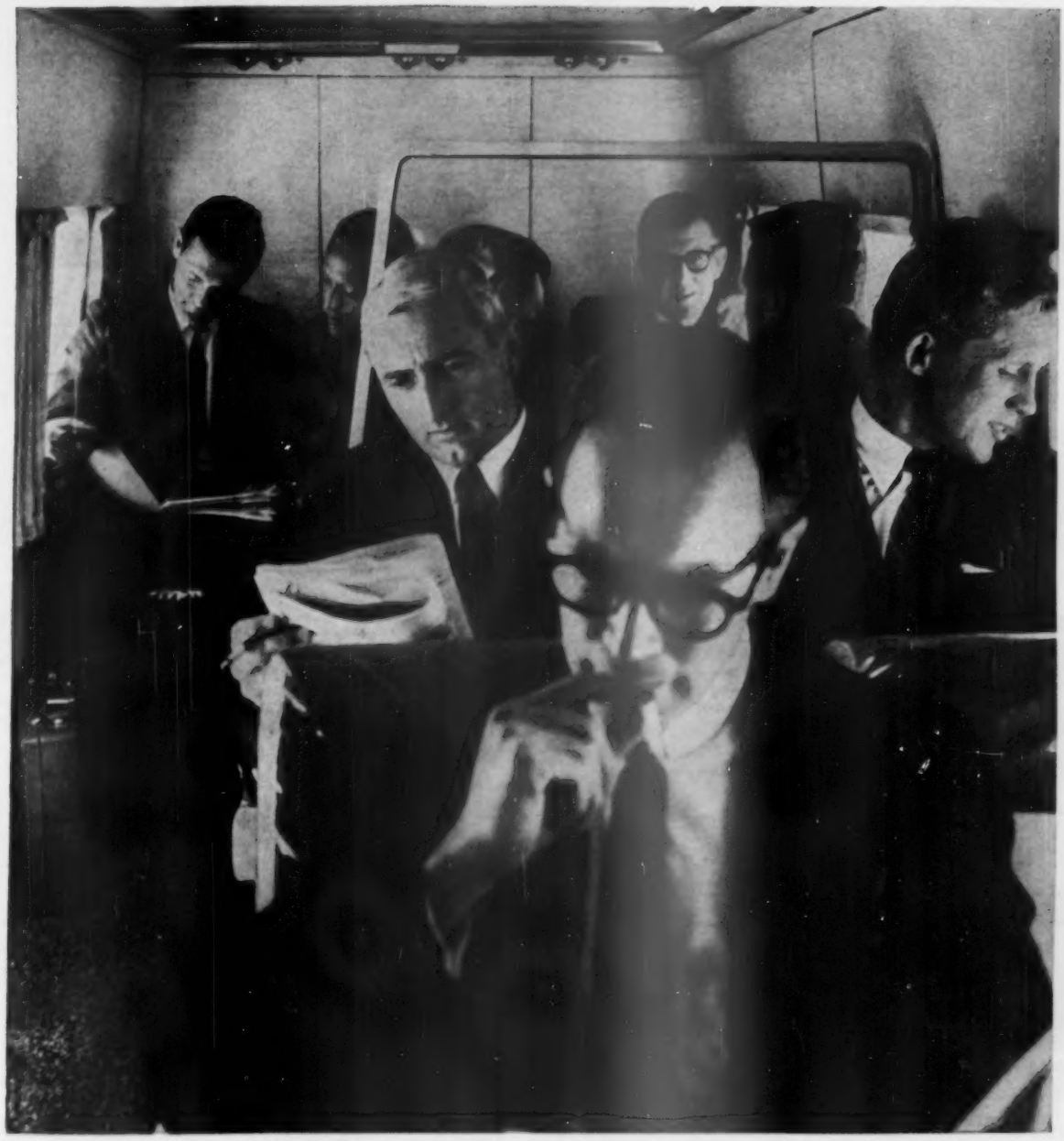
▶ **Continental Air Lines** has been ordered by the Civil Aeronautics Board to continue serving Los Angeles on flights originating at Chicago and continuing to Kansas City and Denver. Continental had petitioned the Board for permission to terminate one daily flight on this route at Denver or Colorado Springs, claiming termination of the flight at Los Angeles is uneconomical with Vickers Viscount and Douglas DC-7B aircraft due to competing nonstop turbojet service from Denver to Los Angeles.

▶ **Civil Aeronautics Board** has dismissed a complaint by United Air Lines against 15 day first class excursion fares offered between Hawaii and Portland/Seattle by Northwest Airlines. United charged the fares on the Honolulu-Seattle/Portland segment were uneconomical and there is no need for reduced fare plans owing to the "excellent public response" to turbojet flights on the route.

▶ **Northwest Airlines** and The Gold Bond Stamp Co. have signed an agreement whereby travelers can fly on Northwest's routes to Florida, Alaska, Hawaii and the Orient by presenting Gold Bond trading stamps to Northwest for air transportation and tours.

▶ **Pan American World Airways** will open a new sales office in the Bristol Orbis Hotel in Warsaw, Poland. Purpose of the office will be to provide information on Pan American, assist passengers whose fares have been prepaid in the U.S. and work closely with LOT, the Polish state airline, which connects with cities in Europe served by Pan American.

▶ **Trans Caribbean Airways** reports that in the first eight months of 1960 it has carried more passengers than it did in the entire year of 1959. The company predicts it will fly 125,000 passengers more than 200 million passenger miles by the end of 1960. Winter schedules call for 16 weekly round trips into the Caribbean area.



Plane, Train or Limousine?

(*none of these, this is a helicopter!*)

Looks like a conference room, doesn't it? Well, it is in a way. The cabin of this new turbine-powered Sikorsky S-62 was designed by Raymond Loewy to make every trip conducive to meetings, study, work and even rest.

The turbine engine not only contributes to this atmosphere with its smooth, quiet operation but also has an unequalled record of reliability to recommend it. And because the mechanical components of the S-62 have been proven in over 1,000,000 hours of flight, periods between overhauls are four to five times longer than would normally be expected of new components.

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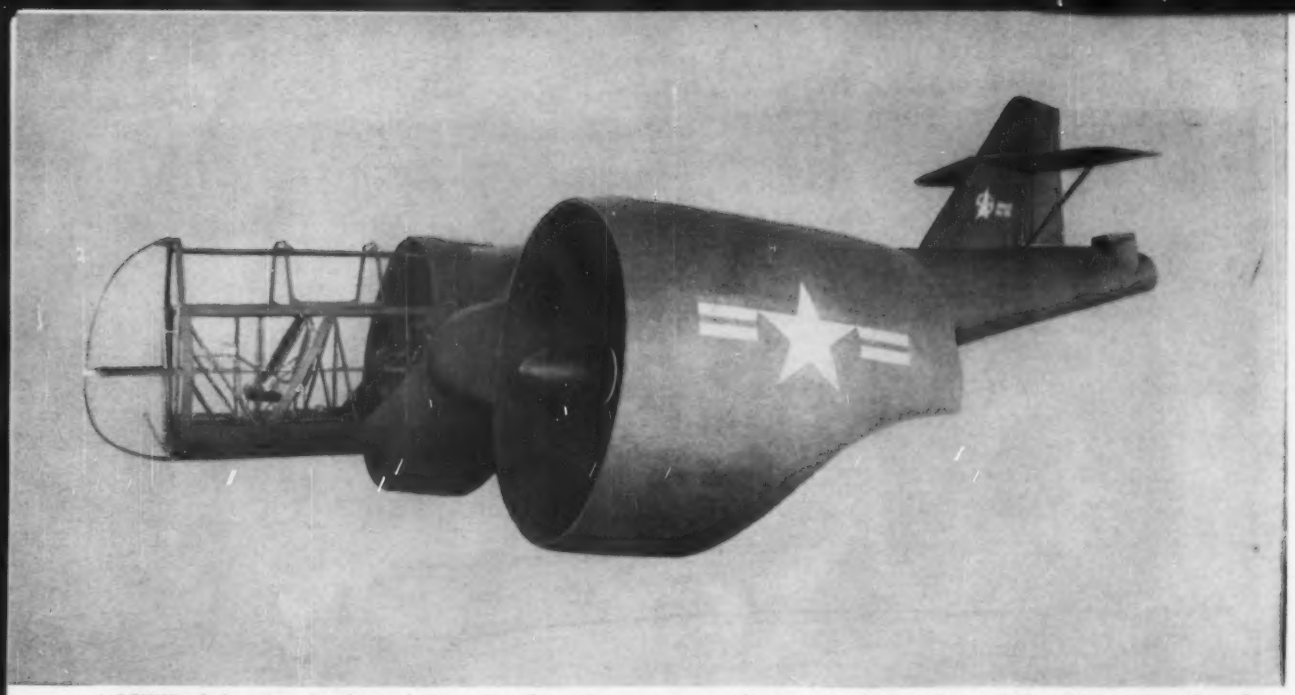
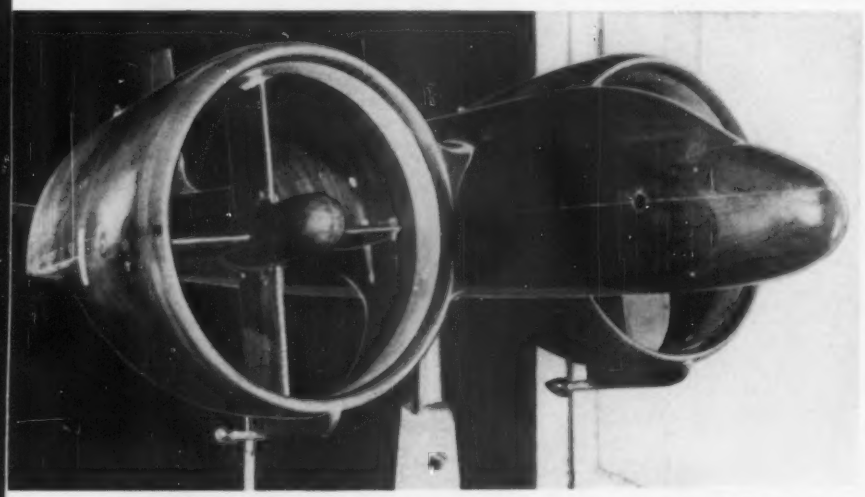
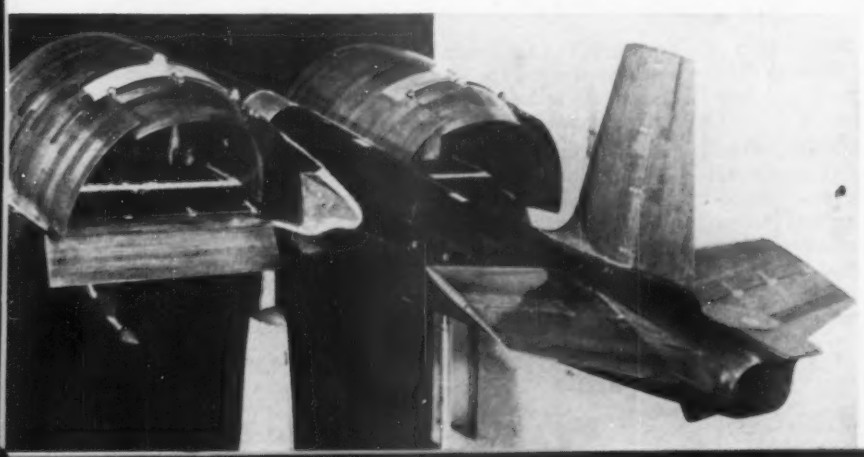


MOCKUP of ring-wing aircraft was built at Piasecki to demonstrate general appearance of a typical test vehicle. Reaction-control nozzle is installed in extended fuselage tail cone.



WIND-TUNNEL MODEL configuration shows appearance of ring-wing installation in a conventional single-place aircraft, either for test or development flying. Skid landing gear is mounted at bottom of ring-wings. Main flaps and aileron flaps are deflected in photo below of Piasecki's ring-wing model. Ailerons act triply as flaps for landing condition, or as flow diverters in addition to providing lateral control. Cascade vanes are not installed here.



Piasecki

By David A. Anderton

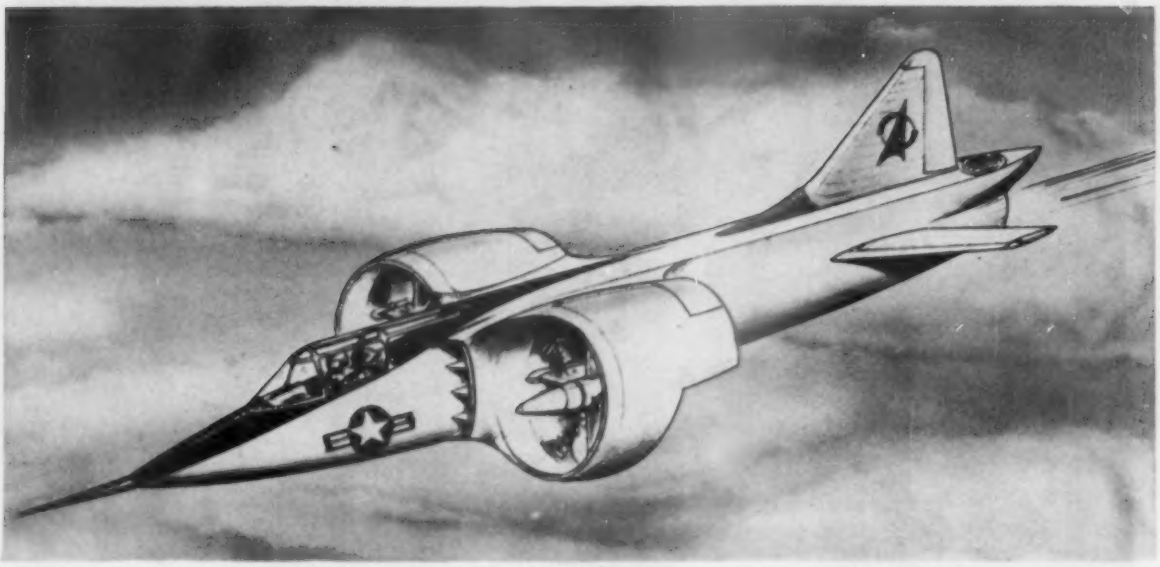
Philadelphia – Ring-wing VTOL concept, which combines propulsion and lift in a single annular unit, has been designed, tested and patented by Piasecki Aircraft Corp.

Concept is built around a shrouded propeller, which produces thrust at increased efficiency compared with a free propeller. But the shroud has been extended partially into a cylindrical surface with a truncated trailing edge. The portion with the longer chord is used as a lifting surface.

Original idea for the ring-wing was developed by Zbyslaw M. Ciolkosz, the company's former chief of design and analysis. An engineering team composed of Ciolkosz, D. N. Meyers, F. E. Mamrol and F. N. Piasecki developed the ring-wing concept. Ciolkosz died earlier this year, and Piasecki Aircraft was the assignee for patent rights.

Design and test data from the four-year development program are currently in final-report stages. Next step planned by the company is to apply the principle to a full-scale flying test vehicle. Piasecki has proposals out along these lines and is hoping for a follow-on contract to carry work into the flying-hardware phase.

Development and test work on the design, including ground runs of the propulsion-lift unit and wind-tunnel tests of a complete model configuration,



HIGH-SPEED FIGHTER proposal utilizing ring-wing principle is one application suggested by Piasecki. Indications are that plane could reach speeds in excess of Mach 1 without flow problems in the ring-wing.

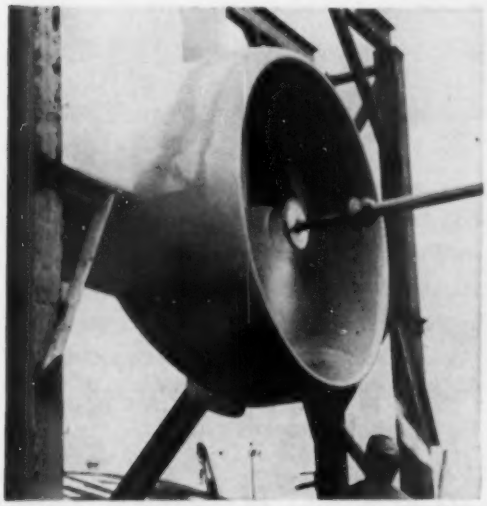
Tests Ring-Wing VTOL Design Concept

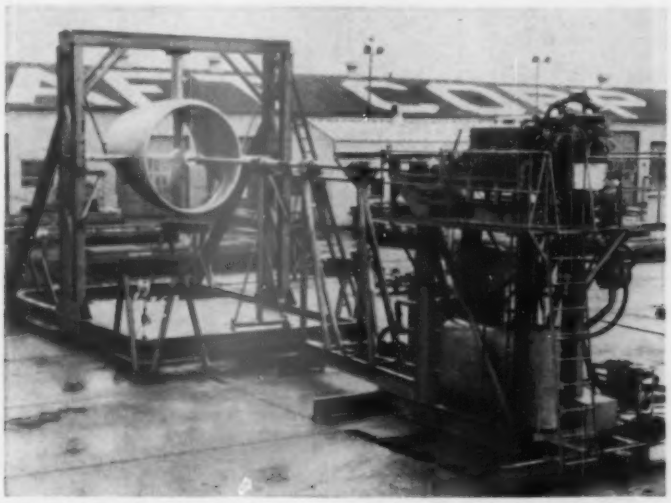
were financed by the U. S. Navy's Bureau of Aeronautics in a contract awarded to the company in July, 1956. Since then, the basic idea has been evolved and refined to develop an aircraft that fits somewhere between the speed ranges of the helicopter and the jet transport.

Frank Piasecki says that the ring-wing is not intended to make the helicopter obsolete, but to do things the helicopter can't do. As an example, he cites a high-speed VTOL fighter along the lines of a light tactical support weapon system.

Inevitably the ring-wing will be compared with other VTOL concepts, including rotatable ducted fans, such as the Doak design, the shrouded turbojet, such as the French Snecma Coleopter, or the ducted fuselage idea, exemplified by Lippisch's Aerodyne. The ring-wing differs from all of these—otherwise it never would have been awarded a patent which recognizes originality and uniqueness—and, again according to Piasecki, doesn't try to do what they are doing.

Aerodynamically the ring-wing started life as a simple propeller with a periph-





SMOKE-FLOW STUDIES were part of static ground runs made with single ring-wing unit on test stand at Piasecki plant. Technician holds smoke generator (lower right in left photo) in various locations around inlet to get visual and qualitative check of flow conditions at zero forward speed. Ring-wing test stand at Piasecki plant (right) shows installation in steel frame suspended at each corner by strain-gage units. Powerplant at right is connected through long extension shaft to propeller shaft of ring-wing. Entire power stand can be swung around pivot at its base (lower right) to whirl rotors on an adjacent testbed frame.

Mere conventional knowledge about metals does not account for the successful welding, machining and spinning that this structure has undergone. The Budd Company has solved many of the critical problems of fabricating a reliable structure from columbium—as well as from other promising new metals such as zirconium, hafnium, beryllium, tantalum and molybdenum.

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eral shroud to increase its efficiency. Use of the shroud eliminates the slipstream contraction behind the plane of a free propeller and increases the static thrust available.

The catch is that as speed increases, the drag of the shroud increases also and the device loses efficiency correspondingly.

One Approach

One way to adapt a simple propeller-shroud combination for VTOL use is to rig a series of cascade flaps behind it to turn the flow through the greater part of 90 deg. and produce a large vertical component due to deflected thrust. But this approach, which looks simple and is logical, is not optimum. Turning losses and drag are higher than desired.

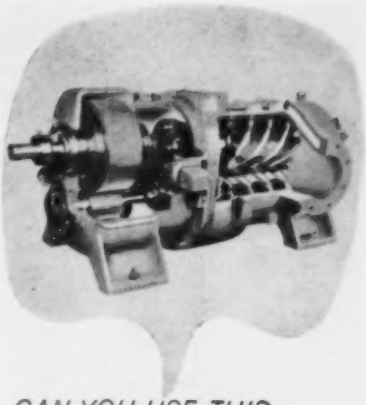
Ciolkosz reasoned that if the wing shroud was going to produce drag anyway, it might be desirable to extend the chord far enough to make it provide lift as well. This way the shroud would serve both as a lifting surface and as a means of increasing the thrust of the propeller. Chord dimensions could be chosen to suit the amount of lift needed.

Next step in the evolution was to add the turning vanes in cascade behind the shroud. But this produces two disadvantages: the distance between the aerodynamic center of the wing and the thrust vector is increased, which produces a destabilizing pitching moment, and the lower portion of the slipstream is turned too closely to the shroud, so that the vanes have to be shifted farther aft, making for increased pitching moment and aggravating the weight and balance problem.

There is one fundamental advantage: the drag situation is improved, because a single unit produces the parasite drag of either a shroud or a wing of the same

880-M Wing Slats Tested in Dynamics Laboratory

Whiffletrees attached to extended leading edge slats on Convair 880-M are connected to a hydraulic ram to simulate flight forces in company's dynamics test laboratory, San Diego. Each wing-half has two slats between the engine pods and two outboard of each outboard pod; they lower stall speed for shorter landings than the 880.



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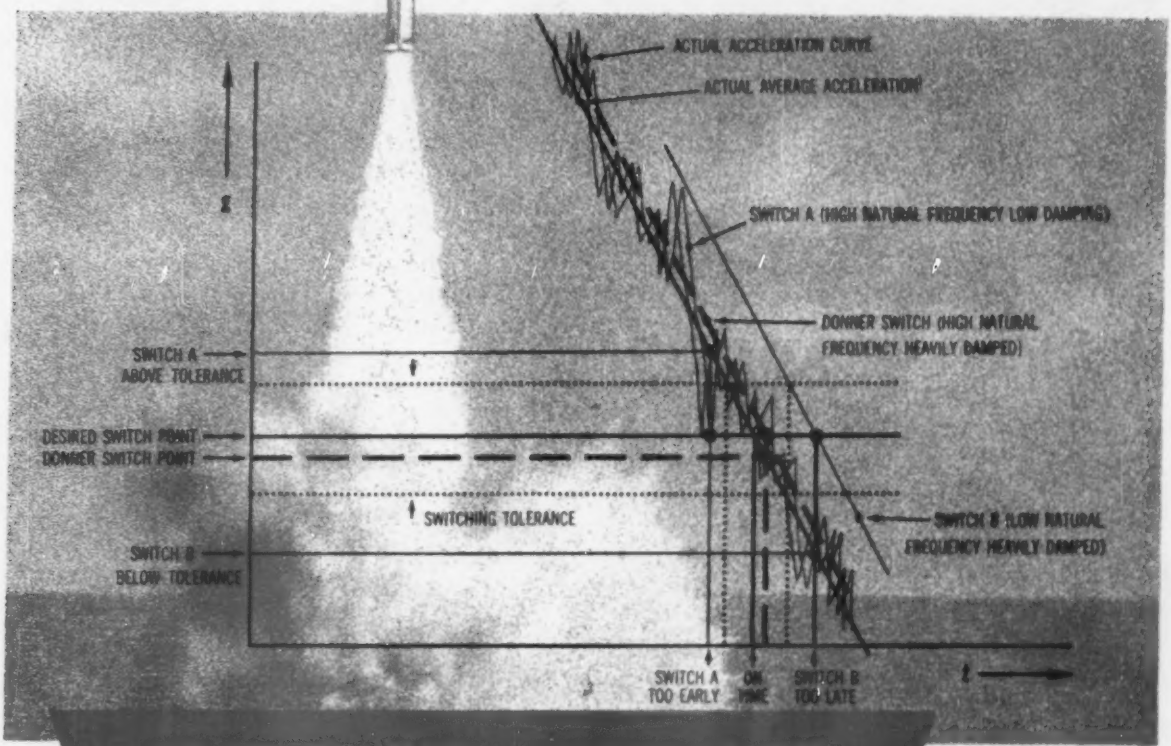
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Look at the graph above. Under static conditions, switch "A" with a better switching response, might be desirable. But suppose the missile were experiencing a 10 g vibration of a high frequency nature and proper thrust cutoff depended on detecting a 2 g switch point. Switch "B" would eliminate the problems of early switching, but introduce intolerable phase shift which in turn would make the switch "see" the event after it actually occurred. In other words, under the dynamic conditions of missile and aircraft flight, it is absolutely necessary to know when an event occurred rather than precisely where it occurred. Frequency response becomes a more important consideration than switch accuracy.

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wetted area, but it functions aerodynamically as both.

The last stage in development of the ring-wing concept was aimed at losing all the disadvantages and keeping the advantages. All the lifting surface was added at the top of the shroud and the lower semicircle of the shroud was cut to the minimum chord necessary for its proper function as a shroud.

Trailing edge of the ring-wing was angled forward and downward to make the transition between the upper lifting surface and the lower shroud. This reduced the distance between aerodynamic center and thrust vector, reducing the destabilizing moment tremendously, and it improved the exit conditions for the lower portion of the slipstream.

Control Surfaces

To this basic design for a combined lift and thrust unit, Ciolkosz added horizontal and vertical stators in the shroud plus flap elements on both upper and lower surfaces. Flaps can be used as deflection aids, as landing flaps or as lateral controls.

Further refinement of the unit came from an annular slot added at the leading edge of the ring-wing to prevent flow separation at low or zero forward speed.

There still remains the problem of pitching moment during transition. Even though this has been reduced to a minimum by the shaping of the ring-wing, it still has to be countered. Ciolkosz proposed that the exhaust from the gas turbines driving the propellers be used to provide reaction control which would counter the destabilizing moment.

The patent also suggested the possibility of using a diffuser section in the lower shroud to increase the area—and therefore the static thrust—of the deflected slipstream. It also mentions the reduced noise level of a shrouded propeller.

Typical Unit

Putting all these components into a single ring-wing unit sounds as if it would be an engineering nightmare, but in practice—exemplified by the simplified test unit built at Piasecki—it isn't bad at all.

Start with the ring-wing itself, with upper semi-annulus of large chord to act as a wing, and the lower portion cut back to shroud dimensions. Mount a single vertical stator and a single horizontal stator, both with leading edges about at the trailing edge of the shroud. At the intersection of the stators mount the variable-pitch propeller, its drive shaft and gear box. Attach hinges and actuators at the trailing edge of the horizontal stator to hold and operate the two main flaps and cas-

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cade vanes. Flaps and vanes retract into a single faired aerodynamic surface extending aft from the stator trailing edge.

Add diffuser flaps to the lower segment of the shroud, to increase the effective area—and therefore the static thrust—of the slipstream. Install a plain flap in the trailing edge of the upper segment to act as a combined flow deflector, landing flap and aileron.

Mount a ring-shaped curved guide vane to the nose of the ring-wing to eliminate flow separation at low forward speed, and the buildup of the ring-wing is completed. Two or more of these units, mounted directly to a fuselage, serve to provide lift and propulsion to the aircraft.

Aircraft Layout

One proposed vehicle was built in detailed model form and tested in the Navy's David Taylor Model Basin wind tunnel. A pair of ring-wings were mounted close to the conventional fuselage. The tail cone was extended to simulate the nozzle through which exhaust gas from the turbines is blasted to counter the destabilizing moment during transition. In the model, there was no flow through this duct.

Reference area for calculating aerodynamic coefficients was arbitrarily chosen as the area of two elliptical wings, each having a span equal to the ring-wing span and a maximum chord equal to the average chord of the ring-wing.

The model was obviously a test vehicle to prove the concept of the ring-wing. Patent drawings show a four-ring-wing configuration planned as a transport; another Piasecki drawing shows a highspeed VTOL fighter.

An unusual feature common to the operation of all these proposals is that the tail is rotated to a low position, while the aircraft is still on the ground, and before going into the vertical lift stage. This is done to rotate the thrust vector to a vertical position; without prerotation, the aircraft becomes an STOL performer.

Operational Procedure

Typical operational procedure for any of these vehicles would be to load with the airplane in its normal three-point attitude. Pilots would complete their check lists, start the engines and then divert—possibly with a special auxiliary control—some of the exhaust air through the rear nozzle. The reaction would tilt the aircraft to the tail-down ground angle necessary for vertical take-off.

All the aids to vertical flight—cascade vanes, main slipstream flaps, exit diffuser flaps and aileron flaps—would then be extended, and the pilot would run the engines up to full power using a low-pitch position on the propellers. By increasing the propeller collective pitch, the vertical vector is built up and the aircraft lifts off the ground.

The pilot starts transition at altitude by pitching the airplane forward to the static ground line attitude. This tilts the total force vector forward and the horizontal component of thrust starts to accelerate the aircraft forward. At some predetermined speed, the cascade vanes are fully retracted, which allows the upper portion of the slipstream to flow directly aft instead of turning. As the speed increases further, the main, diffuser and aileron flaps are slowly retracted and the aircraft continues to accelerate to design speed.

The same sequence in reverse is applied to the vertical landing phase.

In addition to building a full-size mockup of a proposed vehicle and testing the scale model of another vehicle in the Navy's wind tunnel, Piasecki engineers designed and built a test stand to drive a full-scale ring-wing for static tests of the system under operating conditions.

This test stand is a multi-purpose unit, built to enable the engineers to whirl rotor blades, to make tethered flight tests of any VTOL vehicle of reasonable size, and to check the zero-speed performance of the ring-wing unit.

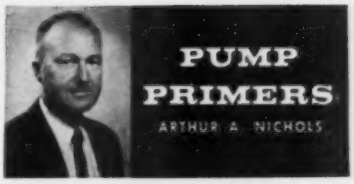
The frame supporting the ring-wing is hung on strain gages so that the entire force system can be recorded during tests, just as with a multi-component wind-tunnel balance system. Propeller of the ring-wing unit is driven by an extended driveshaft from the test stand powerplant.

Where Next?

Piasecki's problem now is where to go with the ring-wing design. Current status is that design and development work has gone about as far as possible without constructing an operational vehicle. Work is still being done refining and reporting test results, and the company has high hopes for follow-on contracts which will enable it to get something in the air.

In times past, Piasecki's personal philosophy has been to do something, to get something built and tested, to get something in the air.

Right now the company efforts are concentrated on getting the second Sky-Car completed and flying, and in working on the various subcontracts that are keeping the machine shop schedule full. But people in the industry who know Piasecki are willing to bet that somehow, before too long, he'll be crawling into the nose section of an ungainly looking aircraft, whose annular wings shroud twin propellers, to make the first flight tests of the ring-wing VTOL aircraft.



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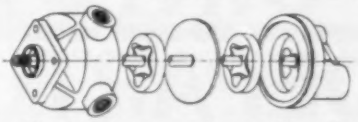

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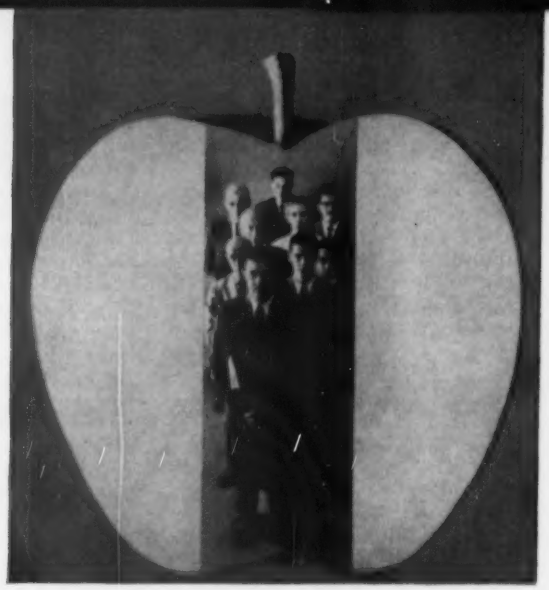

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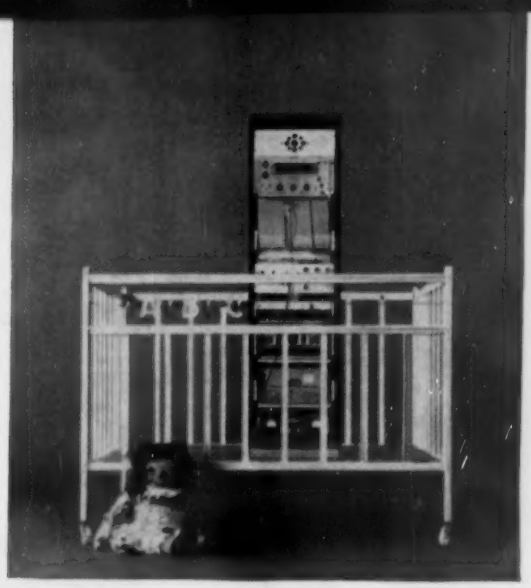

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Short SC.1 VTOL research vehicle rises vertically on the thrust of its four Rolls-Royce RB.108 lifting engines in Farnborough demonstration. Bulbous fairings fore and aft on fuselage are air nozzles for the low-speed reaction control system.

Short SC.1 VTOL Makes Transition at Farnborough

Long-stroke landing gear of SC.1 was designed to absorb energy of 18 fps. descent from hovering configuration. Plane was demonstrated at Farnborough from this platform, made transition from vertical to forward flight and back again.

Delta wing layout of SC.1 was chosen as compromise between well-tested geometry and possible plan for future VTOL vehicle using jet lift. Four lift engines are augmented by single propulsion engine. Plane has auto-stabilizing system as pilot aid at low speeds, tied to reaction control system utilizing high-pressure air bled from the lift engines. Below, SC.1 taxis on rain-swept runway at Farnborough under power from its single RB.108 propulsion engine. Grill on fuselage mid-section protects lift engine intakes; forward-facing flaps at intake grill are gills to provide increased air supply for air starts of the lift engines during wing-borne flight.

LIQUIDOMETER electronic-electromechanical instrumentation

for space vehicles • aircraft • ground support units • test facilities

Liquidometer combines the vision of original design with the dependability of long experience to qualify as a major source of instrument and control systems. Capabilities in design, development, and production are outlined in a new Liquidometer booklet available on request.

Your inquiry is invited.

THE LIQUIDOMETER CORP
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Since 1920 LIQUIDOMETER INSTRUMENTS ...of proven quality

PRODUCTION BRIEFING

Evaluation models of a 10-lb. video correlator developed by Chance Vought Electronics Division will be supplied to the Navy. Dollar value of the contract is not disclosed. System occupies less than one cubic foot of space and is adaptable to existing aircraft, land or ship-based radars, the company notes.

Video correlators and continuous-performance monitors will be produced for the U. S. Marines by Linge-Temco Electronics, Dallas, Tex., under a $500,000 contract. Both items will update Marine radar equipment and delay its obsolescence some five years.

Allison turboprop-powered Convair executive transport has been delivered to Ford Motor Co. following installation of an executive interior, Sperry integrated instrument system, Sperry A-12 autopilot and automatic approach system, wiring for a transponder, installation of additional fuel capacity and instrument panel changes, which was done by AiResearch Aviation Division of Garrett Corp., Los Angeles.

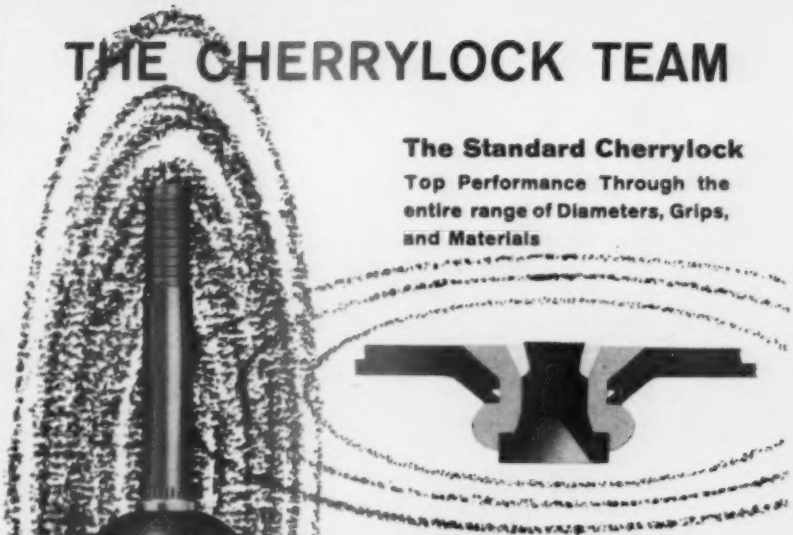
ILS glide slope receiver, costing $695, is in production at National Aeronautical Corp. (Narco) at its Ft. Washington, Pa., facility for business and private aircraft. Designated UGR-1, the unit weighs 6.75 lb. with shock mount and measures 5-in. x 5-in. x 10-in. Type-certificated under C-34 Category B, the UGR-1 can operate from any 50-ohm glide slope antenna. Unit utilizes "hybrid tubes," eliminating need for separate power supply. With 20-channel capacity it switches automatically to the proper UHF glide slope frequency when the localizer frequency of the Narco Mk. VI or 1016A equipments are tied to it.

Eleven catapult bridle and pendant arresting systems for evaluation aboard aircraft carriers will be produced by vanZelm Associates, Baltimore, Md., under a $700,000 Navy contract. System delivery begins this November.

Kellett Aircraft Corp., Willow Grove, Pa., will produce handling stand adaption kits for ground support in missile operations under a new contract awarded by General Electric Corp. in connection with U. S. Army Ordnance requirement for a type of handling truck for positioning and aligning nose cones on missiles.

General Electric's CF700 aft-turbofan engine completed its second unofficial 150-hr. endurance run in less than a month.

THE CHERRYLOCK TEAM



The Standard Cherrylock

Top Performance Through the entire range of Diameters, Grips, and Materials

The Bulbed Cherrylock

Specifically for Thin Sheet and Double Dimple Applications— Even Greater Strength in the Short Grip Ranges

Only the Cherrylock "2000" Team Gives you All These Advantages

- Mechanically Locked Stem
- Flush Fracture (No Stem Trimming)
- Positive Clamp-up
- Full Grip Range
- Complete Hole Fill
- Positive Visual Inspection (Grip Marked on Head)

A-286 Stainless Steel—Monel—Aluminum

The Cherrylock* "2000" series team offers the finest, most adaptable aircraft rivets yet developed. Maximum joint strength and reliability are obtained by using the Standard Cherrylock and the Bulbed Cherrylock to cover the entire range of applications. The Bulbed Cherrylock for short grips and double dimple, the Standard Cherrylock in the longer grips. Both types are installed with the same H-610 series pulling head, using existing Cherry guns.

Higher joint strength allowables, close blind side clearance, and the widest grip range available—only with the Cherrylock Team—result in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

* * *

For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent No. 2931532

CHERRY RIVET DIVISION

Townsend Company

SANTA ANA, CALIF.

In Canada: *Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario*

NASA Contracts

The National Aeronautics and Space Administration awarded the following contracts, totaling more than $134 million, during the period Jan. 1, 1960, through June 30, 1960. The figures shown represent the estimated total cost of the contract.

GODDARD SPACE FLIGHT CENTER, Greenbelt, Md.

Kraus Periodicals, Inc. New York, N. Y. —$26,151—Periodicals.

Litton Industries of Maryland, Inc. College Park, Md.—$39,187—Machine shop services.

Machinery Associates, Inc. Wynnewood, Pa.—$31,310—Two precision toolmaker's lathes.

Magline, Inc. Pinconing, Mich.—$40,374 —Nike Cajun hardware.

Marshall, Inc. Clinton, Md.—$78,276— Construction of operations building and associated utilities at Blossom Point, Md., Minitrack station.

Mauer (J.A.), Inc. Long Island City, N. Y.—$27,704—70 mm, aerial lens camera, filter and magazines for use in sounding rocket program.

Minnesota Mining and Manufacturing Co. St. Paul, Minn.—$30,624—High resolution tape, reels and instruments for meteoro'ogical satellite program.

New Mexico College of Agriculture and Mechanical Arts University Park, N. M.— $725,787—Minitrack field services and related support.

Norair Engineering Corp. Washington, D. C.—$1,452,000—Construction of central power plant and services shops at Greenbelt.

Phelps Dodge Copper Products Corporation, Habirshaw Cable and Wire New York, N. Y.—$59,464—Polyethylene jacketed stipoflex transformer cable for use in Minitrack network.

Plasmadyne Corp. Santa Ana, Calif.— $58,000—Study and design of ultra-violet air density meter.

Rand Corporation Santa Monica, Calif.— $114,441—Theoretical study of certain aspects of the earth's magnetic field and the space environment near the earth.

Radiation Inc., Systems Development Division Orlando, Fla.—$52,846—Replacement cords for automatic reaction and reduction facility.

Radiation Inc., Melbourne, Fla.—$87,981 —Digital data recording system.

Radiation Instruments Div. Laboratory Chicago, Ill.—$109,918—Devise multi-channel pulse height analyzer for use in sounding rocket program.

Raymond Engineering Laboratory, Inc. Middletown, Conn.—$66,999—Seven Tiros II magnetic tape recorders.

Schellenger Research Laboratory, Texas Western College of University of Texas El Paso, Texas—$50,000—Procure and operate sound ranging system for meteorological satellite program.

Thiokol Chemical Corp., Elkton Division Elkton, Md.—$36,075—Cajun model rocket engines.

United Technology Corp. Palo Alto, Calif. —$148,402—Study feasibility of conical segmented rocket motors.

Varian Associates Palo Alto, Calif.— $30,000—Research to develop an alkali vapor spectral lamp for use in lunar and planetary exploration program.

Washington Technology Associates, Inc. Rockville, Md.—$97,652—Development of payload for Aerobee 100 rocket.

Varian Associates Palo Alto, Calif.— $56,351—Development of rubidium vapor magnetometers and furnishing of engineering services.

New York University New York, N. Y.— $75,057—Study of problems associated with transmission and reduction of time and material data.

Consolidated Electrodynamics Pasadena, Calif.—$29,447—Study directed toward the development of one megacycle flight recorder.

Radio Corporation of America, Astro-Electronics Products Div. Princeton, N. J.— $302,324—Design, develop, fabricate, acceptance test and deliver a laboratory model of an electrostatic TV satellite camera.

Tenney Engineering Union N. J.—$35,052 —High vacuum thermal chamber.

Thompson Ramo Wooldridge, Inc., Tapco Group Cleveland, Ohio—$4,300,000—Development of Sunflower solar auxiliary power system.

Raymond Engineering Laboratory, Inc. Middletown, Conn.—$25,000—Tape recorder.

Radio Corporation of America, Astro Electronic Products Div. Princeton, N. J.— $55,806—Evaluation of Tiros I data.

North American Aviation, Inc., Rocketdyne Div. Canoga Park, Calif.—$206,861— Development of lithium-cooled rocket engine exhaust nozzle.

North American Aviation, Inc., Rocketdyne Div. Canoga Park, Calif.—$256,443— Investigating compatibility of high temperature potassium with containment materials.

Ohio Semi-Conductors, Inc. Columbus, Ohio—$33,720—Develop two sensor vector component magnetometers.

Elgin Micronics Division, Elgin National Watch Co. Elgin, Ill.—$32,788—Drive mechanisms.

General Electronic Laboratories, Inc. Silver Spring, Md.—$25,680—Telemeters.

Ampex Corp. Redwood City, Calif.— $40,200—Magnetic tape recorder.

Elliott Co. Washington, D. C.—$39,260— Lathe.

Cooper Development Corp. Monrovia, Calif.—$37,000— Develop and manufacture of telemetering systems.

Beckman Instruments Bethesda, Md.— $31,765—Spectro-reflectometer.

Grand Central Rocket Co. Redlands, Calif.—$423,294—Design, development, fabrication and tests necessary to demonstrate feasibility of a unique rocket and develop a prototype version.

LEWIS RESEARCH CENTER, Cleveland, Ohio.

William Zoellner Plumbing and Heating Co., Inc. Sandusky, Ohio—$37,895—Services, labor and material for installation of air hydraulic control cooling water and oil lubrication systems for Plum Brook Reactor Facilities at Sandusky, Ohio.

Phillips Electric Co. Cleveland, Ohio— $29,900—Services, labor and material for installation of telephone instrumentation cables, ducts and manholes.

MSA Research Corporation Callery, Pa. —$106,850—Two phase sodium loop.

Condenser Service and Engineering Co., Inc. Hoboken, N. J.—$27,455—Services and material to fabricate, machine, assemble, clean and test one Dewar vacuum jacketed tank for Plum Brook.

Associated Piping and Engineering Co., Inc. Compton, Calif.—$64,000—Pulse welding two-channel assemblies.

Diamond Power Specialty Corp. Lancaster, Ohio—$34,873—Closed circuit TV system for Plum Brook.

Jarrell-Ash Company Newtonville, Mass. —$26,910—Spectrometer and associated equipment.

Hermes Electronics Co. Cambridge, Mass. —$33,500—Master time code generator for Plum Brook.

Maddock-Weaver, Inc. Mentor, Ohio— $25,974—Services, labor and material for landscaping and grounds maintenance.

Stauffer-Temescal Company Richmond, Calif. —$130,000 — Electron bombardment unit.

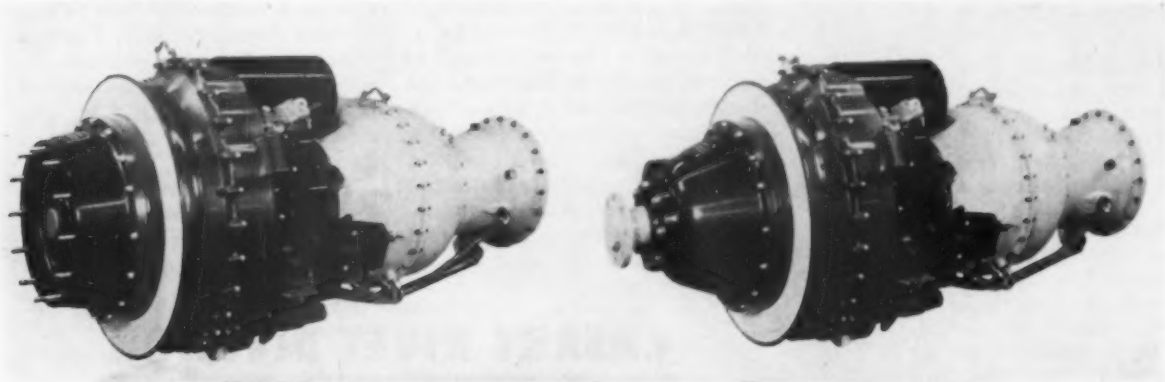
Edward L. Feick Sandusky, Ohio—$40,000—Services, labor and material for construction of four shop buildings and first aid station for Plum Brook.

Electro Instruments, Inc. San Diego, Calif. —$119,068—Amplifiers for use on rocket research.

Cleveland Electric Illuminating Company Cleveland, Ohio — $1,608,050 — Electrical power.

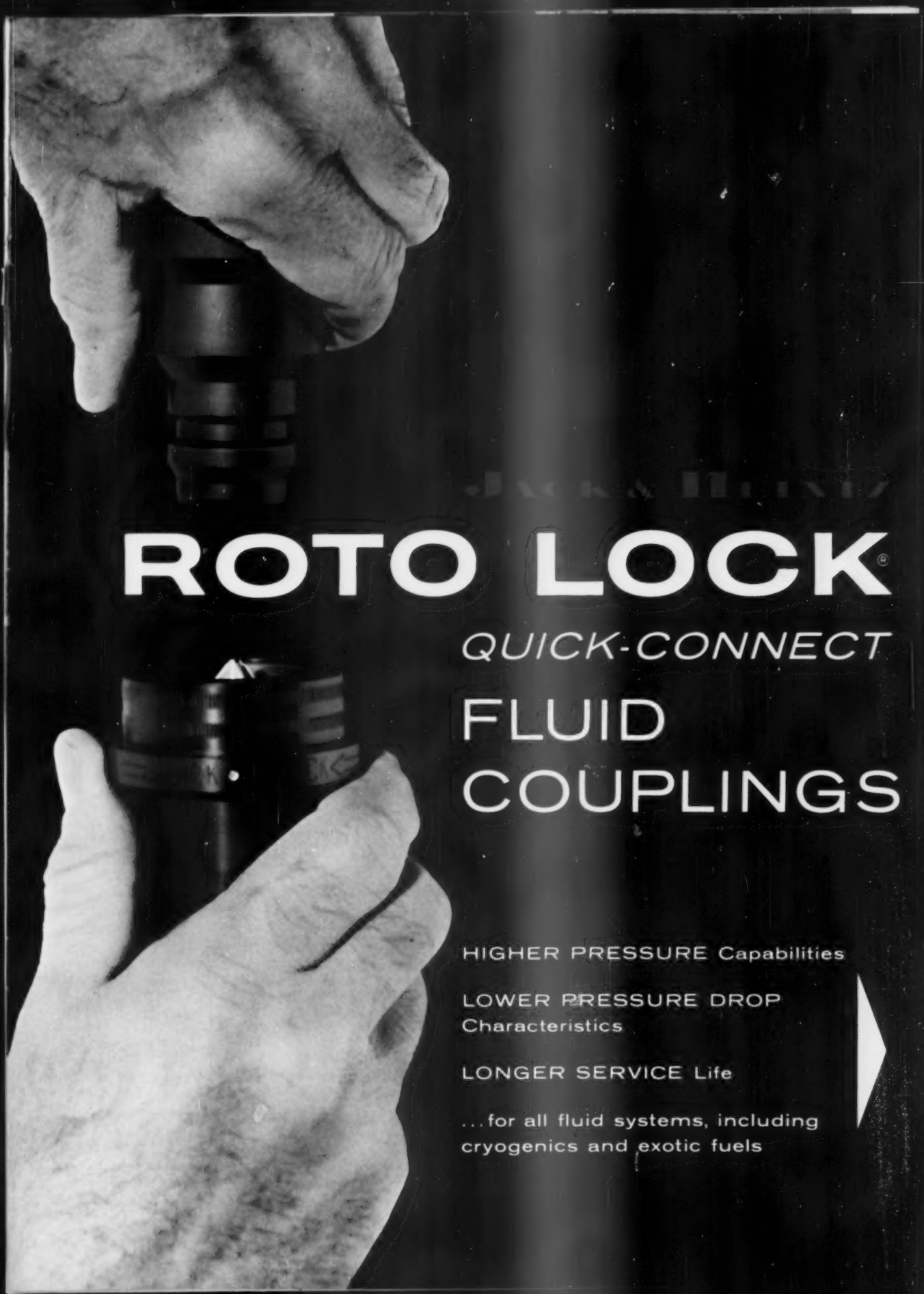
Elliott Company Jeannette, Pa.—$63,200 —Steam ejector-condenser system for Plum Brook.

Webb Electric Company Detroit, Mich— $44,003—Services, labor and material to install instrumentation and control equip-

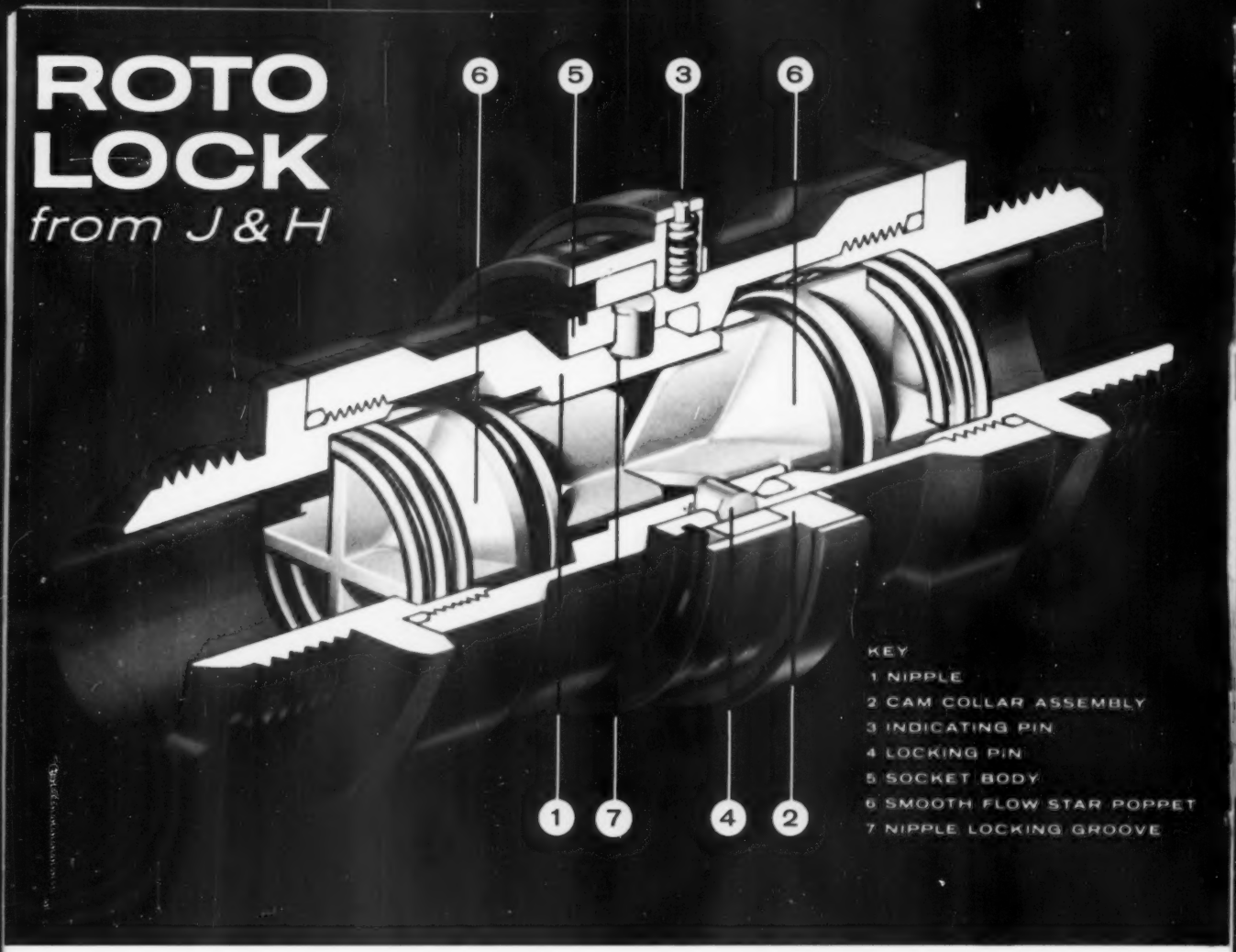


Continental Building Model 217-5A Turboshaft Engine

Continental Aviation & Engineering Corp. currently is building the first complete Model 217-5A turboshaft engine, (AW Sept. 5, p. 31); engine is designated T72-T-2 by U. S. Navy. Company expects to start 50 hr. qualification tests next April. Provisions will be made for vertical installation and operation and requirements for supercharging and air condition will be built into the engine. Engine develops 500 shp. and weighs 210 lb.


ROTO LOCK®
QUICK-CONNECT
FLUID
COUPLINGS
HIGHER PRESSURE Capabilities
LOWER PRESSURE DROP
Characteristics
LONGER SERVICE Life
...for all fluid systems, including
cryogenics and exotic fuels

ROTO LOCK *from J&H*



High-pressure handling...low-pressure drops...long service... 3-way open-close signal...make ROTO LOCK top-ranking coupling

The ROTO LOCK quick-connect coupling, technical features of which are outlined briefly here, has been proved in service in missile, aircraft and ground support applications. Its performance has been outstanding.

Jack & Heintz, a prime designer and manufacturer of secondary-power systems and components, now makes this superior unit more broadly available not only for its many immediate applications, but for the many advanced applications which can benefit from its capabilities by adaptations in design.

Every prime need of quick-connect coupling users, as indicated by surveys, is met by new ROTO LOCK. These are the most important improvements it brings immediately to the designers of fluid-handling systems:

Ease of connection—one quick twist of actuating collar connects; one twist in opposite direction, disconnects.

Higher fluid pressures—1″ coupling proof rated at 3000 psi in aluminum. Higher ratings dependent on size and material.

Lower pressure drops—less than 3.1″, H_2O at 6 gpm for the 1-inch coupling.

Longer service life—"balanced-load" character of locking mechanism doubles service life compared to conventional units.

Longer seal life—simplified sealing reduces wear, speeds replacement, eliminates secondary seals.

Better coupling condition signal—indicating mechanism provides sensory, audible *and* visible signal of open or coupled.

Adaptability to need—will handle any fluids from air through exotic fuels; can be made in wide range of materials, including plastics; easily adaptable to special requirements.

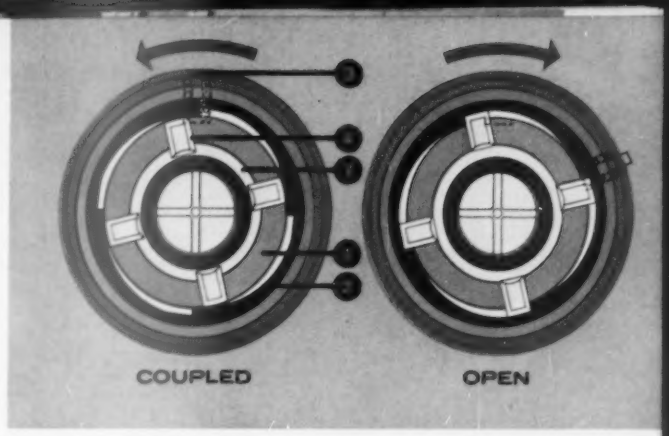
How these improvements are provided by ROTO LOCK is shown on this page. Specific application data and performance analyses are available on request. Sizes and designs available for immediate application are listed on next page.

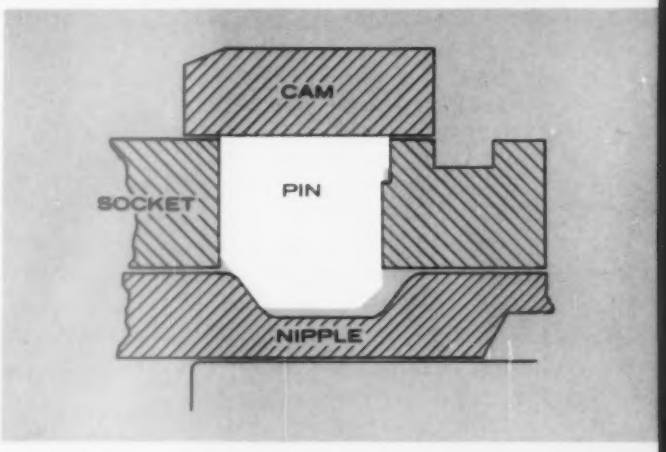
LOCKING PINS KEY TO PRESSURE CAPABILITY, LONG SERVICE LIFE: Locking pins can be seen in the cutaway and the two top illustrations. This design provides a maximum contact of pin, nipple groove, socket body and cam. Net result is an optimum load distribution . . . high-pressure capability. This balanced distribution also virtually eliminates "Brinelling"... prime cause of conventional coupling failure... accounting for ROTO LOCK'S long service life. The mechanical advantage of the cam and chamfered mating surfaces pull the nipple into tight lock.

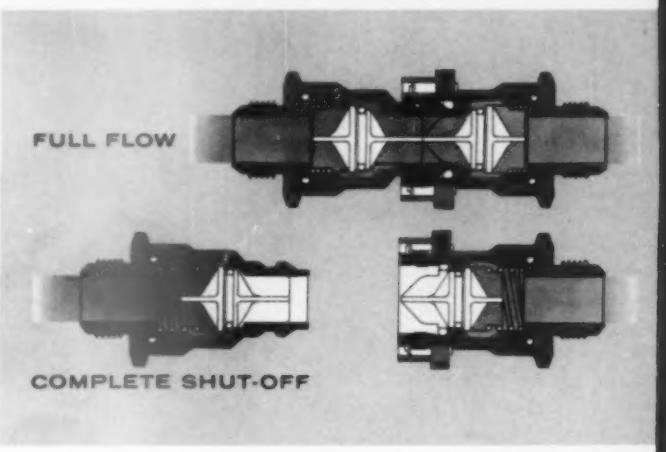
INDICATING MECHANISM GIVES 3-WAY SIGNAL OF COUPLING CONDITION: The indicating mechanism, top right, is a simple, spring-loaded pin. At "open", this pin projects above the cam collar. As collar is rotated to "coupled", pin rides socket body until it finds and seats firmly within flat-bottom hole in nipple body. At this point, coupling is completely locked, pin is flush with collar surface. As the pin seats, a definite click is heard providing a visible and sensory signal of coupled condition.

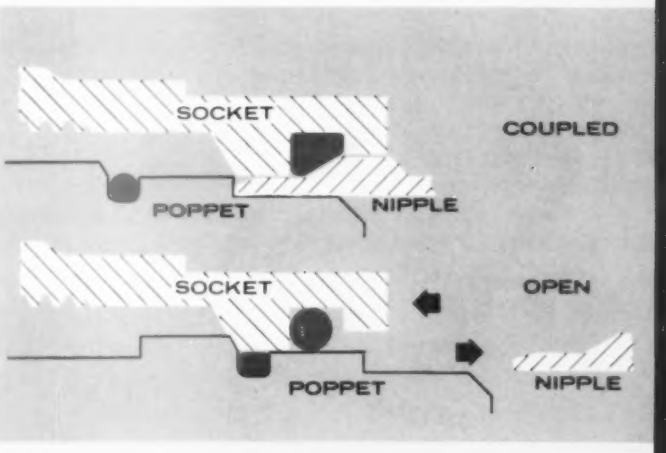
"STAR" POPPETS REDUCE PRESSURE DROP: Cutaway reveals unusual poppet configuration which results in maximum freedom of fluid flow, shown right. ROTO LOCK pressure drop is considerably less than military specifications. In disconnect position, positive self-sealing action is assured by heavy stainless springs and "O" rings recessed in the poppet. ROTO LOCK can be supplied with poppets in both socket and nipple, in socket only, or nipple only.

SIMPLIFIED SEALING HOLDS PRESSURE OR VACUUM: Line drawings, bottom right, show condition of seals during connect and disconnect. This simplified seal construction is so effective that safety or secondary "O" ring or face seals are unnecessary. Note that sloping surface of the nipple body provides an escape-proof location for nipple-socket seal, enabling it to seal with equal effectiveness against very high pressures or vacuums. Note also that the location is remote from damage during connection.



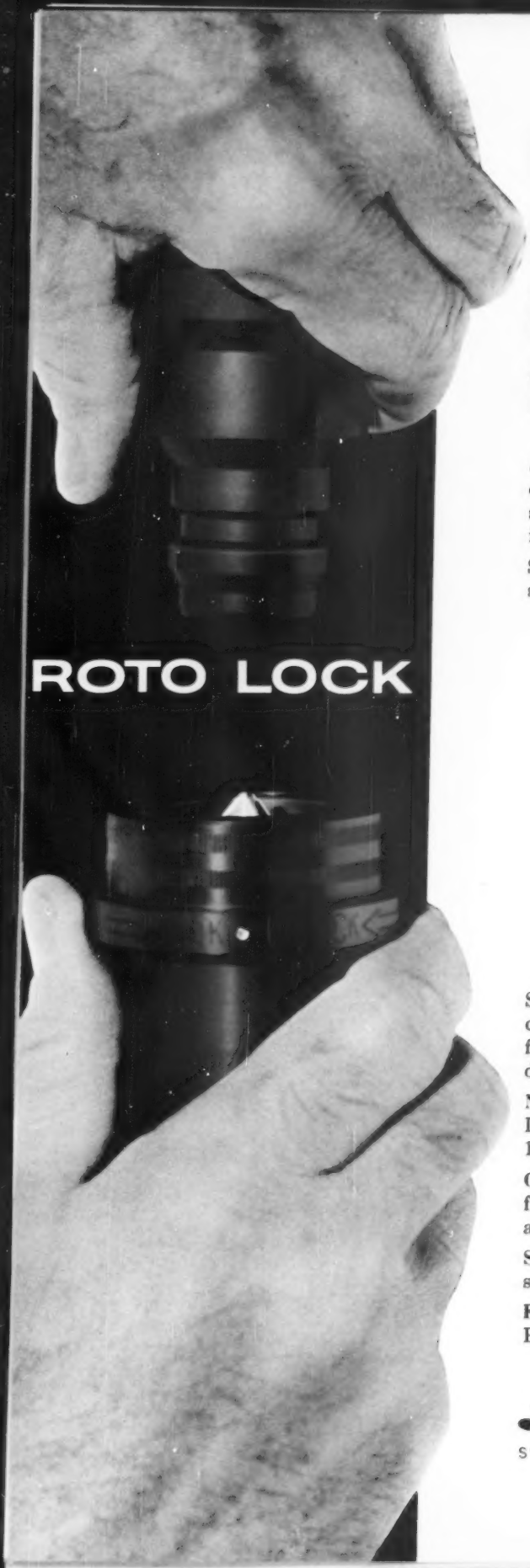






JACK & HEINTZ, Inc.

SYSTEMS FOR AIRCRAFT, MISSILES AND GROUND SUPPORT



New ROTO LOCK immediately available in sizes and types for all fluid handling

J&H is producing ROTO LOCK series 10/11 for the extreme requirements of the military and aero-space fluid systems. These units are designed and tested to conditions in excess of MIL-C-7413A.

Series 10/11 is immediately available in the following sizes, types and materials:

Sizes: ¼″, ⅜″, ½″, ⅝″, ¾″, 1″, 1¼″, 1½″, 2″, 2½″ and 3″

Types: Open and self-sealing types with many end styles including:

MS33656 (Flared tube)
MS33657 (Flared tube bulkhead)
MS33514 (Flareless tube)
MS33515 (Flareless tube bulkhead)

AND 10058 (hose)
Bulkhead hose
Male and Female Pipe Thread
Nipple Caps and Socket Plugs available for all sizes.

Materials: Aluminum (Standard), Stainless Steel, Brass and Plastic.

Series 10/11 is the first of a complete line of couplings to cover all requirements of fluid handling, ranging from foodstuffs through cryogenics. In addition, other basic design series include:

No-Air Inclusion Couplings: One push connects and locks. Designed to meet MIL-C-25427. Available in sizes through 1¼″.

GSE Couplings: Built to meet MIL-C-25531A. Designed for air-start, air-handling and other ground or air-borne applications.

Special Designs: J&H will design couplings to meet any special need, in any size or material.

For further information please write to Jack & Heintz Inc., P. O. Box 6719, Cleveland 1, Ohio.

JACK & HEINTZ, Inc.

SYSTEMS FOR AIRCRAFT, MISSILES AND GROUND SUPPORT

ment in the Rocket Combustion Laboratory.

The T. J. Hume Co., Lorain, Ohio—$97,600—Services, labor and material for construction of the High Energy Rocket Research Facility Control Building at Plum Brook.

The Klein Steel Co., Bellevue, Ohio—$38,840—Services, labor and material for the fabrication and erection of structural steel for the Altitude Rocket Test Facility at Plum Brook.

Condenser Service and Engineering Co., Inc., Hoboken, N. J.—$27,000—Services and material to fabricate, machine and assemble one Pilot Vacuum Tank.

Drever Co., Bethayres, Pa.—$32,890—Vacuum sintering furnace.

Consolidated Vacuum Corp., Rochester, N. Y.—$28,350—Vacuum pumps and associated equipment (Oil diffusion ejecter type).

Kinney Vacuum Division, New York Air Brake Company Boston, Mass.—$49,824—Vacuum pumps and associated equipment. (Rotary type.)

General Vacuum Corp., East Boston, Mass.—$52,387—Vacuum pumps and associated equipment (Lobe type).

NRC Equipment Corp., Newton Highlands, Mass.—$106,050—Vacuum pumps and associated equipment (Oil diffusion type).

Gustav Hirsch Organization, Inc. Columbus, Ohio—$31,470—Services, labor and material to install, connect and test a remote area monitoring system for the Reactor Facility at Plum Brook.

The Collier Construction Co., Strongsville, Ohio—$47,500—Services, labor and material for installation of additional control and communication transmission cables at Plum Brook.

Ampex Corp., Birmingham, Mich.—$66,433—Magnetic tape recording system.

Statham Instruments Los Angeles, Calif.—$40,600—Pressure measuring devices.

The R. Hansen Co., Cleveland, Ohio—$29,701—Services, and material for alterations to the Altitude Wind Tunnel Test Rig.

Gustav Hirsch Organization Columbus, Ohio—$47,400—Services labor and material for installation of electrical wiring and equipment for facilities at Plum Brook.

Deinera and Lindroth Cuyahoga Falls, Ohio—$26,000—Services, labor and material for fog, fire and alarm systems for facilities at Plum Brook.

Tech Service Silver Springs, Md.—$31,746—To provide instrumentation panels to measure stresses in research at Plum Brook.

Bomarc Gets Checkout

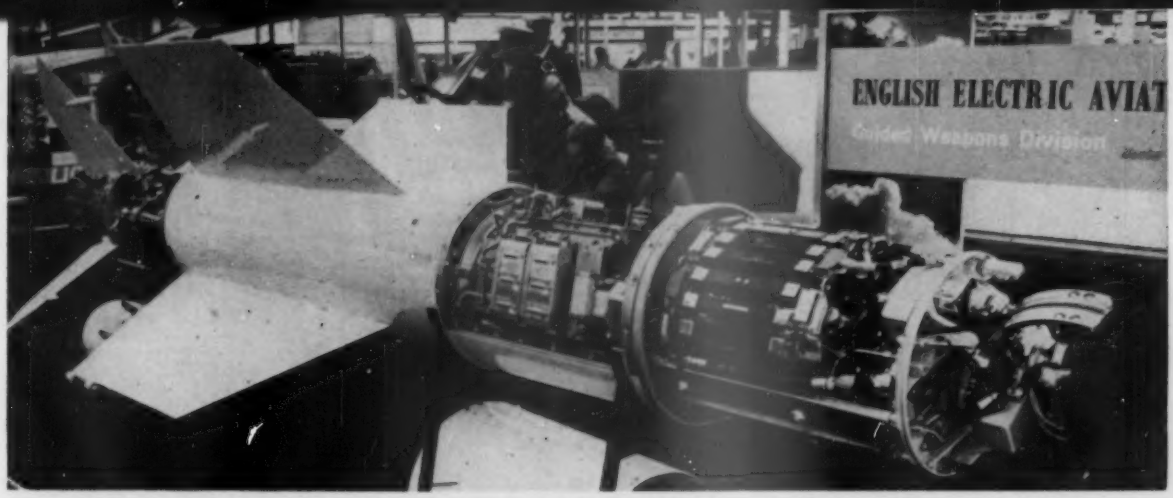
Boeing IM-99A Bomarc interceptor missiles are seen lined up in the assembly and maintenance hangar (below) for checkout, including simulated flight, by technicians of the 4751st Air Defense Sqdn. (Missile), Hurlburt Field, Santa Rosa Island, Fla. Located in the Eglin AFB complex, Hurlburt backs up Bomarc A and B development firing trials over the Gulf range and has added mission of training new IM-99 crews and aiding proficiency exercises of current units, which visit the firing site. Since July 1959, five Bomarc squadrons have been trained here. View above shows Hurlburt fueling crews loading a Bomarc with red fuming nitric acid oxidizer for its liquid rocket booster. Current protective clothing is resistant to acid penetration for only three minutes, according to Eglin technicians, but they note that new clothing soon will be in use providing protection for several hours.

MISSILE ENGINEERING

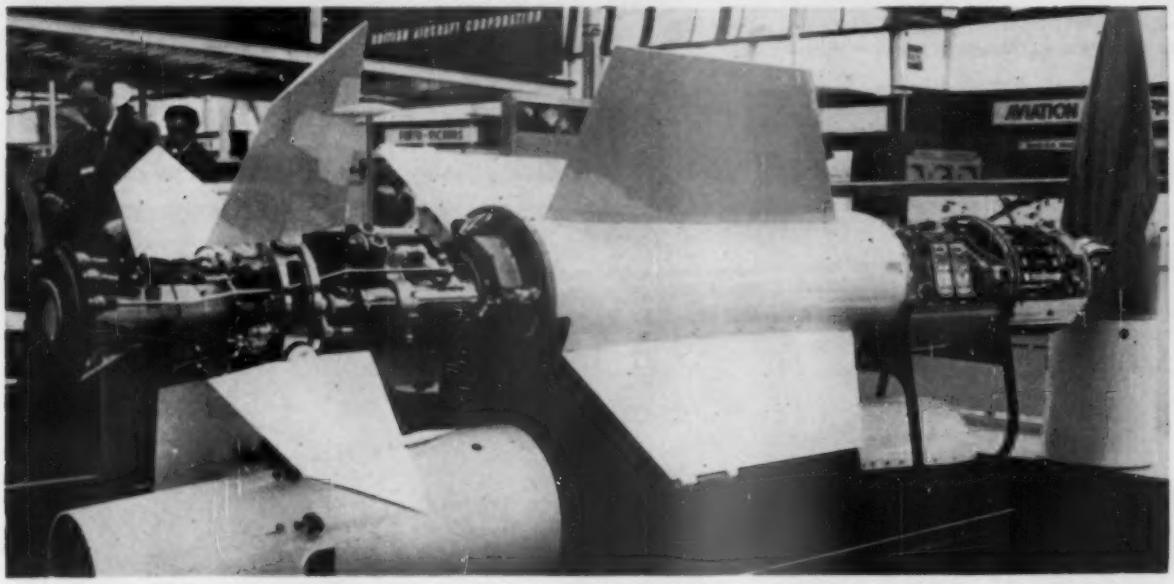
Four English Electric Thunderbird anti-aircraft missiles with tracking and support equipment are displayed at Farnborough.

British Demonstrate Thunderbird Battery

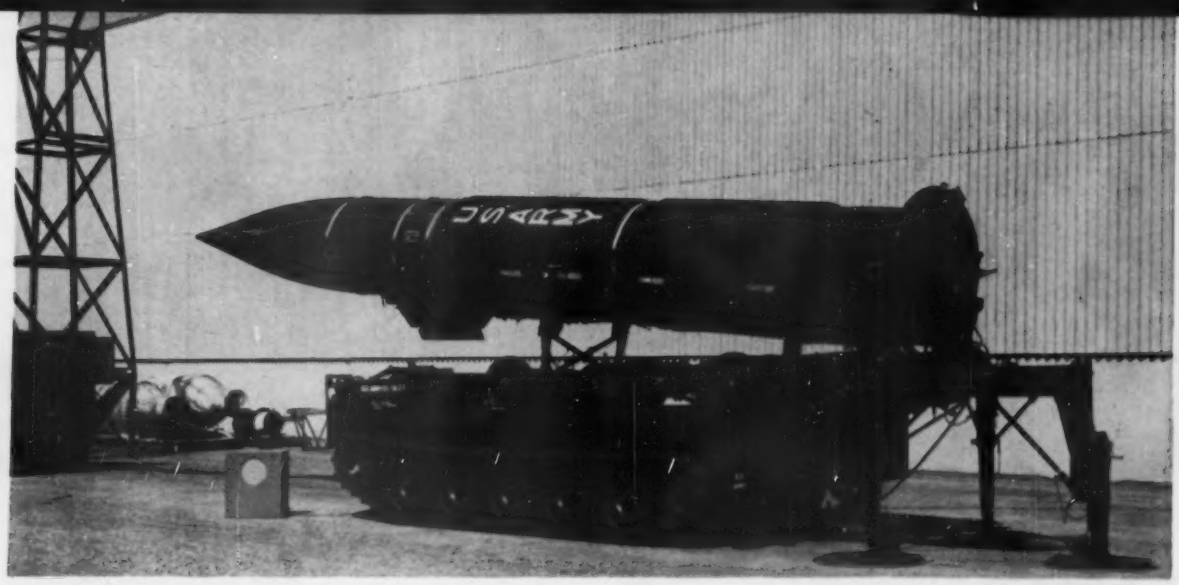
After simulating Thunderbird launching, battery members of Royal Artillery lower replacement missile on launcher.



English Electric static exhibit at the 21st Flying Display of the Society of British Aircraft Constructors at Farnborough, England, includes a Thunderbird with panels removed to show interior design. Radar and other instrumentation are visible.



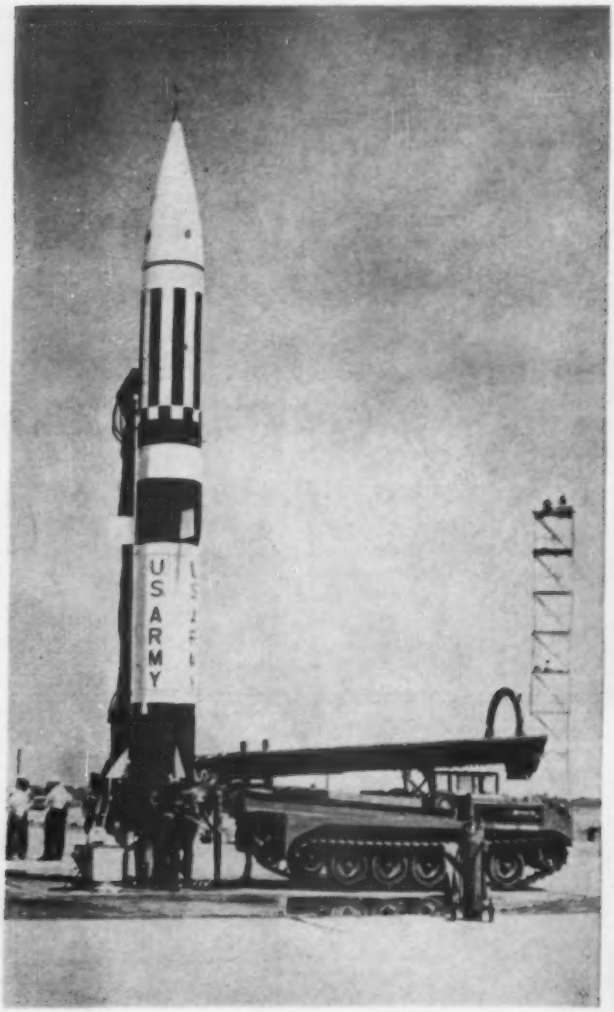
Thunderbird's solid-propellant sustainer engine and guidance vanes are shown above. At left below, members of the 36th Anti-Aircraft (G.W.) Regiment of the Royal Artillery guide a Thunderbird onto a dolly. At right, a truck is backed into position so a Thunderbird can be loaded through an Armstrong Whitworth Argosy cargo transport's swing-type door.

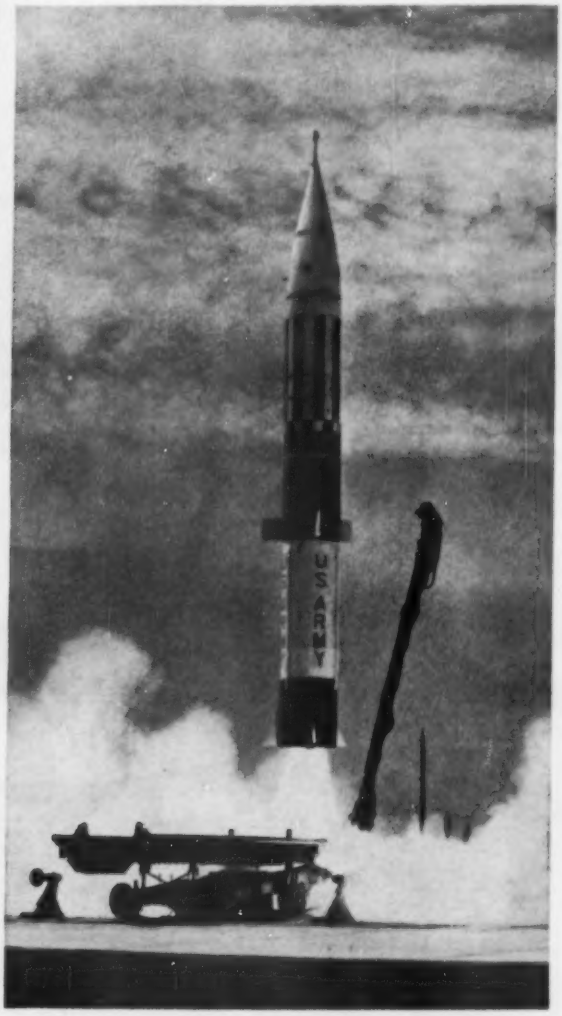


MARTIN PERSHING two-stage, selective range ballistic missile is mounted on a transporter-erector-launcher (TEL) manufactured by the Tapco Group, Thompson Ramo Wooldridge, Inc., and is carried by an XM474 tracked vehicle made by Food Machinery Corp.

Pershing Mobility Demonstrated to Army

ARMY PERSHING two-stage ballistic missile is fired from its mobile launcher during tests at Atlantic Missile Range, Cape Canaveral, Fla.





TRANSPORTER-erector-launcher, readily transportable by air, has four wheels and pneumatic tires that enable it to be towed short distances and maneuvered into position, permitting movement, erection and launching of Pershing in a matter of minutes.

Washington—U. S. Army commanders in Europe got their first view of the prelaunch operation of the Pershing missile system last month in a demonstration of the weapon's mobility.

Mobility show was held for Seventh Army field commanders at Finthen Army Base, Bad Kreuznach, Germany, in an exercise of ground support equipment from alert through prelaunch checkout. Pershing, now being test-fired at Atlantic Missile Range, will replace the larger, liquid-fueled Redstone throughout the Army.

In the demonstration, Food Machinery Corp. XM474 tracked vehicle brought the two-stage missile and its launcher from a wooded area to launch site at 40 mph., negotiating a three-foot embankment in the move. Soldiers of 40th Artillery Group operated the system after only a few days training, including performing missile make-ready functions.

Army credits fast reaction and mobility to the solid propellant motors, XM474 vehicle and Tapco Group transporter-erector-launcher (TEL).

First launching using 17-ft. vehicle and TEL was made in July (AW Aug. 8, p. 89). Development schedule calls for full two-stage propulsion flight with the two Thiokol motors before the end of the year. Both stages have been fired in captive sequential tests.

TEL includes a dual-track erector on a transporter chassis which has four wheels so that it can be maneuvered at the firing site. Launch platform, supported by leveling jacks, is mounted on the rear of the transporter on a pivot and has an azimuth ring. Erector raises the missile to its firing positon, with reusable mast supporting preconditioning, checkout and launch control cables.

Complete tactical package consists of the 34-ft. Pershing, which has diameter

XM474 is a lightweight, track-laying vehicle with exceptionally high ground mobility.

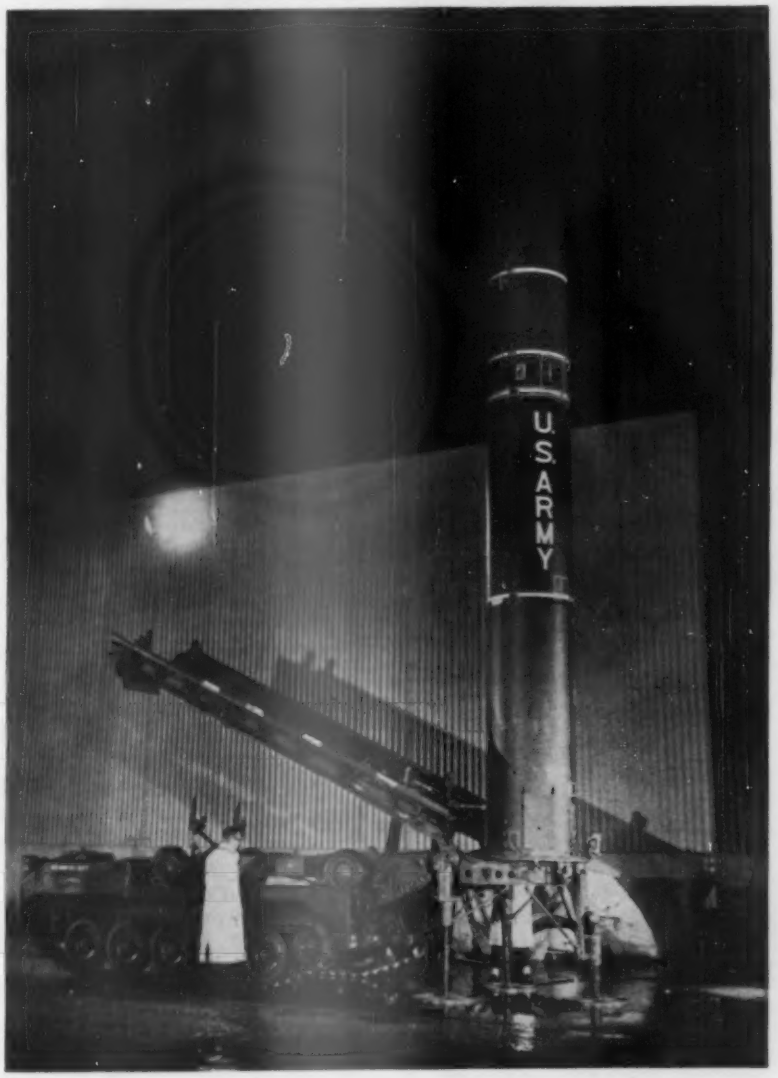


Photo: Courtesy Westinghouse Air Arm Division

Congratulations!

to WESTINGHOUSE for an exciting breakthrough.

A RADAR RECEIVER NOISE FIGURE of 2.8 db at an X-band operating frequency has been achieved by engineers of the Westinghouse Air Arm Division. Dr. Robert Rampolla (left), and Mr. Thomas Hollis (right), using a true non-degenerate X-band parametric amplifier and a Microwave Associates "pill" varactor (MA-4253), achieved a 20 db gain with excellent stability and ample bandwidth.

This remarkable accomplishment in low-noise amplification at X-band resulted from research on a program sponsored jointly by Westinghouse and the U. S. Navy.

Sophisticated Varactor technology at Microwave Associates which made these results possible has produced the most complete line available of advanced varactors in standard, miniature "pill", and glass packages.

Write for detailed information and performance data on varactor techniques.

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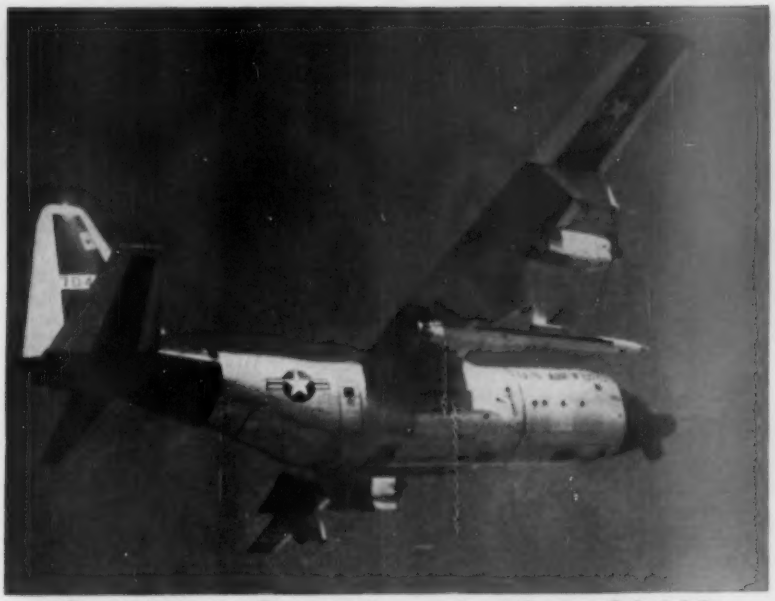


Q-4B Missile Target Launched From GC-130

USAF-Radioplane Division of Northrop Corp. Q-4B supersonic missile target makes its first free flight from Lockheed GC-130A launching platform over desert near Holloman AFB, N. M. The drone attained controlled speeds up to Mach 1 without using the afterburner of its 3,850-lb.-thrust General Electric J85-5 turbojet engine.

of 40 in., TEL, power pack, communications, fire control and checkout equipment. It is air-transportable or can be moved with the XM474 vehicle. TEL system with the missile can be mounted on the XM474, or landed by helicopter at the launch site.

Selective-range Pershing, in 300-mi. mid-range version, is expected to go to troops in 1963 (AW Aug. 29, p. 33), with work on longer-range development being done concurrently.

Bendix to Operate Pacific Downrange Missile Stations

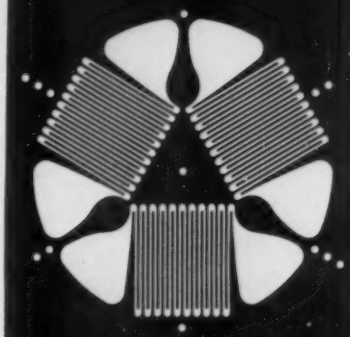
Washington—Bendix Corp.'s Radio Division has been awarded a $1.6 million Navy contract for operation and services at the Wake, Eniwetok and Midway Island downrange stations of the Pacific Missile Range.

The division also will operate the Kaneohe Communication Center in Hawaii.

Short Seacat Anti-Aircraft Missile

Short Seacat Navy short-range anti-aircraft missile is shown on quadruple launcher aboard a ship mockup at Farnborough, England. Seacat is powered by a small two-stage, solid propellant motor. Radar unit in center is probably used to aid in tracking targets.

UNIFORM!



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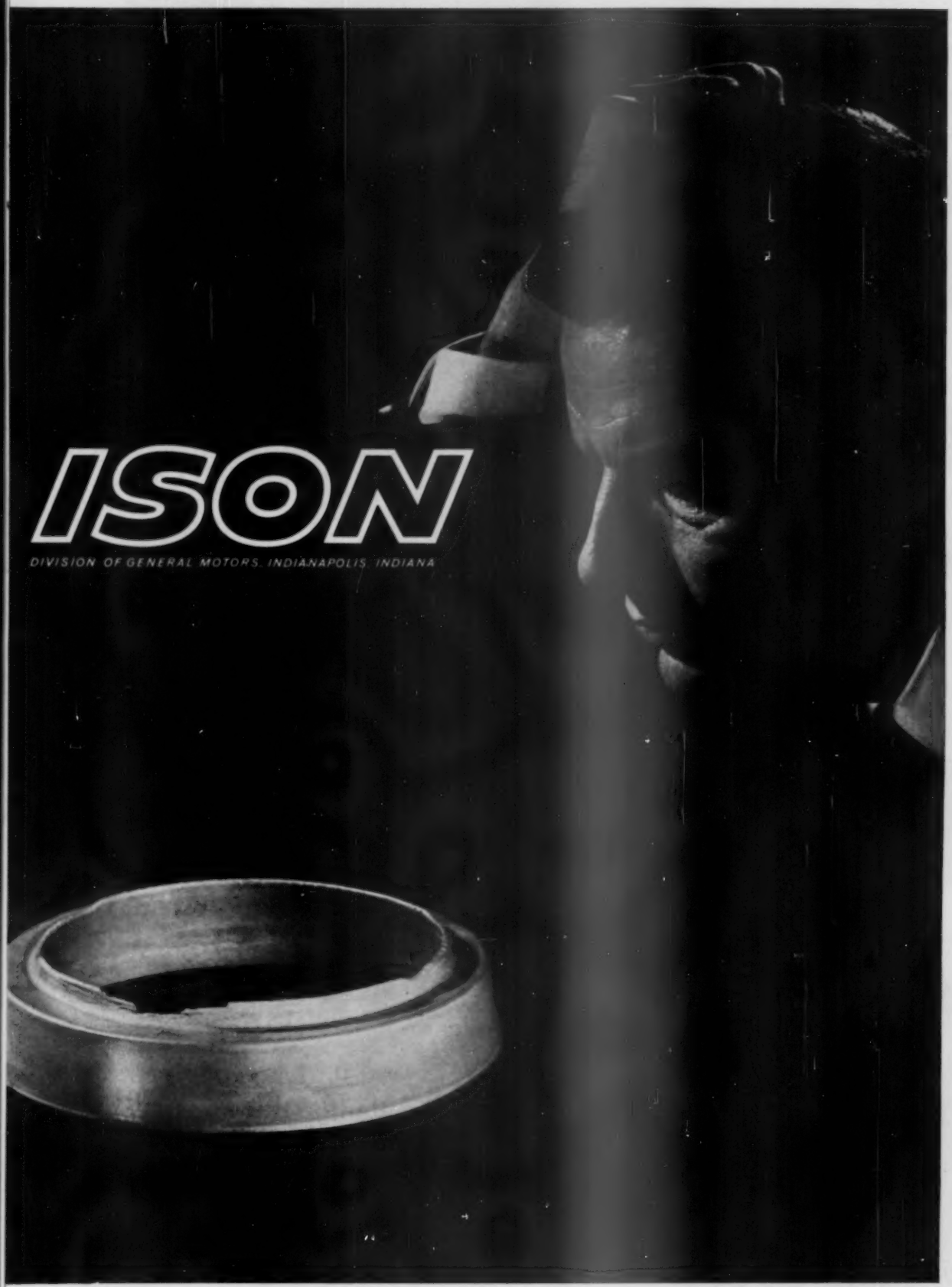
Illustrated is a refractory metal nozzle liner segment formed by a combination of plasma-arc spraying and forging.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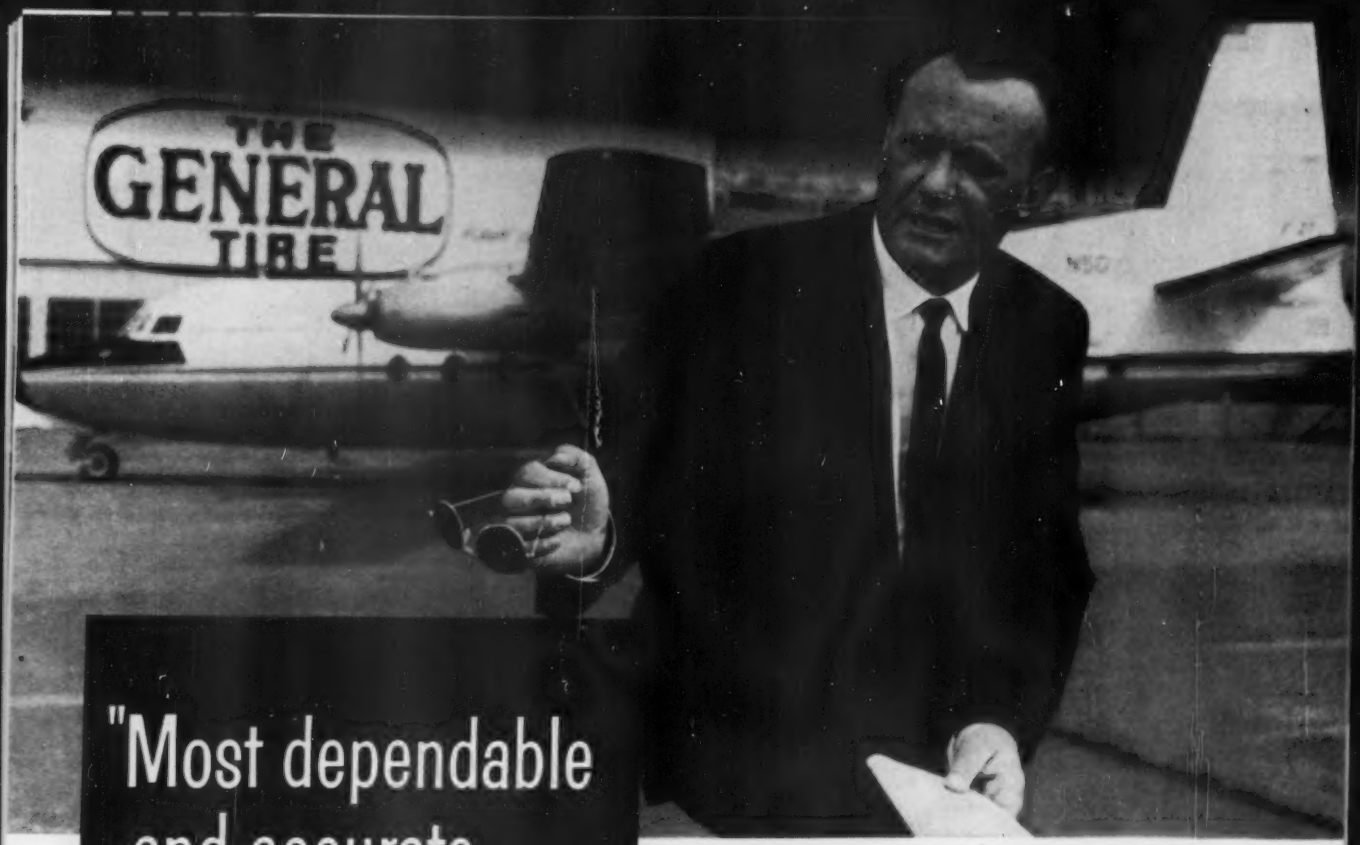

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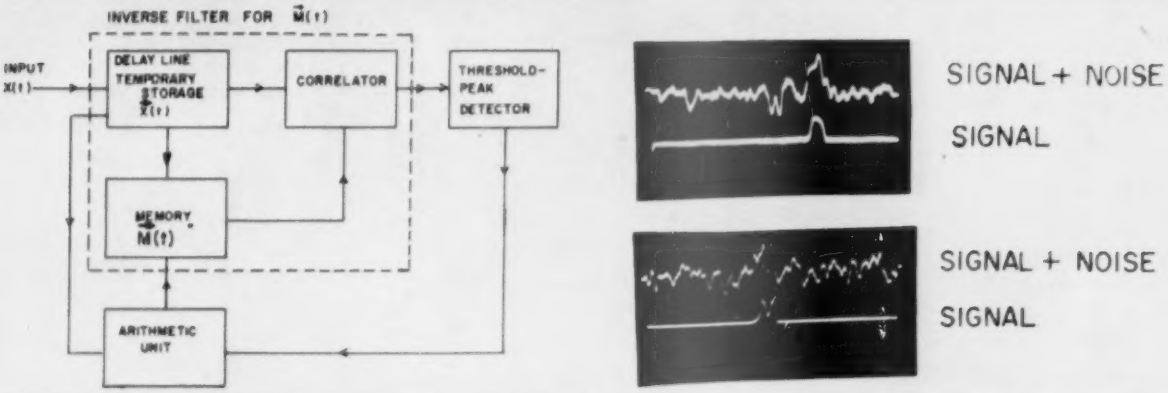


SELF-ADAPTING filter (left), developed by General Electric, learns to identify fixed waveform signals occurring in random manner that are buried in noise without prior knowledge of their waveform or presence. Block diagram shows major circuit elements. Two samples of waveforms used in GE tests are at right. These have signal-to-noise ratio of 10, but filter has operated with lower ratios.

Filter Detects Signals Buried in Noise

By Philip J. Klass

Schenectady, N. Y.—Fundamentally new type of circuit that automatically learns to identify fixed waveform signals occurring in a random manner and buried in noise, without prior knowledge of their waveform or presence, may find important applications in electromagnetic reconnaissance, radar and communications.

The new technique, called Adaptive Waveform Recognition, was developed here by scientists in General Electric's Research Laboratory. It has demonstrated the ability to detect signals that are so buried in noise that they can not be detected by human observers who knew in advance the nature of the signal, the company reports.

Significant Advance

Adaptive waveform recognition marks another significant advance in the field of adapting, or self-learning, control systems. Representative of this promising new type system are the Cornell Aeronautical Laboratory Perceptron (AW July 7, 1958, p. 60, July 4, p. 72) and the self-adapting autopilot (AW Sept. 22, 1958, p. 60).

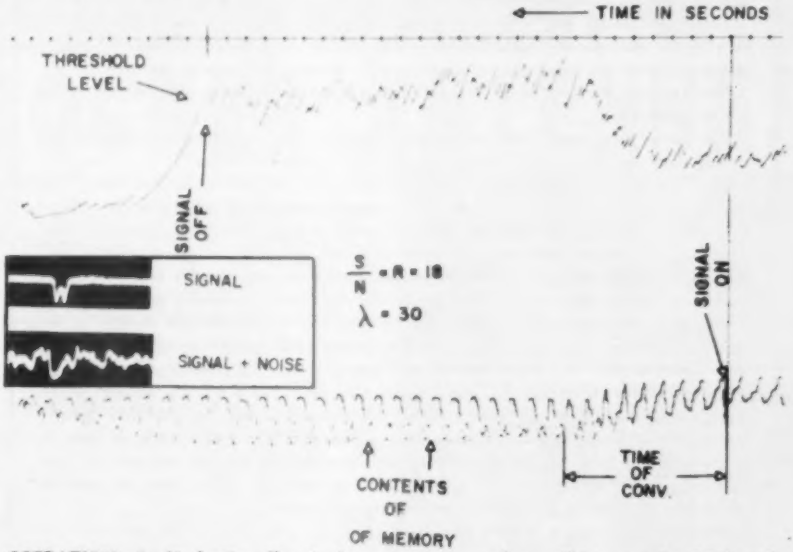
First disclosure of the new self-adapting filter technique was made earlier this month in England at the Fourth London Symposium on Information Theory in a report jointly authored by C. V. Jakowatz, R. L. Schuey and G. M. White, all of General Electric.

Experiments conducted by General Electric scientists demonstrate the novel characteristics of the new technique. Initially the filter receives an input consisting solely of Gaussian noise of zero mean, which it does not pass. Then a signal is introduced in combination with the noise. For one typical experiment, the signal consists of negative M-shaped pulses of about seven milliseconds duration repeated 30 times per second at randomly spaced intervals in time.

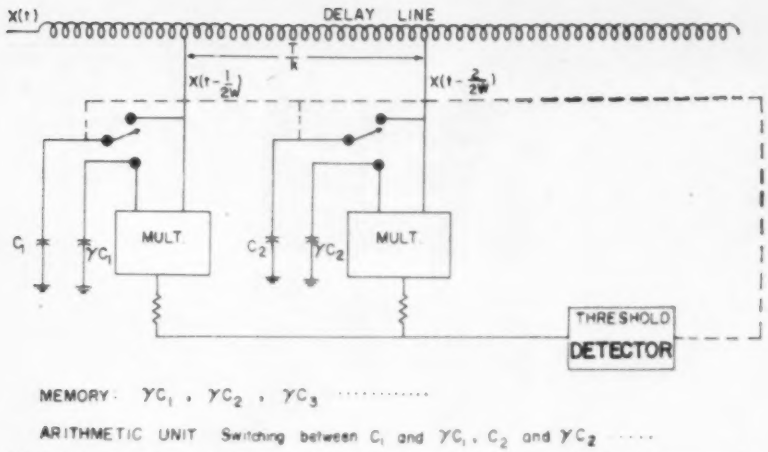
Within several seconds after the first signal pulse appears, the filter begins to alter its response. Within a few more seconds the filter is fully adjusted to the incoming signals and passes them. If and when the signal disappears, the filter automatically returns to its original no-pass condition.

The capability described to this point is not too impressive because it could be exhibited by a conventional filter matched to the particular signals involved, assuming signal characteristics were known. But now suppose that the waveform of the signal pulses is radically altered to a different configuration, of different duration, repetition frequency and signal-to-noise ratio. Without any change in the self-adapting filter circuitry, it will automatically sense the new signals and adjust itself to pass the new waveform.

It is this flexibility, or self-adapting



OPERATION of self-adapting filter is shown in test recording. Using negative M-shaped pulse repeated randomly 30 times per second with signal-to-noise ratio of 18, filter required convergence time of eight seconds to detect presence of signal, modify its memory to conform to signal waveform and to raise threshold level. Time moves right-to-left.



• **SCHEMATIC** shows how input waveform momentarily stored in delay line is compared in increments with filter's estimate of signal waveform, stored in capacitors γC_1, γC_2. Vector product of each is obtained by multiplier and outputs of all multipliers are then totaled and compared with reference value by threshold detector to determine if there is sufficient similarity between actual waveform and one stored in memory. If so, arithmetic unit is activated, causing capacitors C_1, C_2 . . . to transfer portion of input signal from delay line into memory capacitors, enhancing accuracy of replica of signal waveform there.

Adaptive Filter Analogy

Principle of operation of General Electric's newly developed adaptive filter, and the way in which its operation differs from a conventional matched filter, can be illustrated by the following analogy.

Suppose that an orchestra is to play for a very exclusive party at which many gate crashers are expected to use any ruse to gain entry. Entrance through the stage door is controlled by a guard of extremely low mentality, corresponding to a filter in an electronic circuit.

If each member of the orchestra is given a special pass for the occasion, and if the guard is given a copy of the pass and told to admit only people bearing such passes, then the situation is analogous to a matched filter in which the guard/filter has advanced knowledge of the identification of persons/signals to be passed.

Suppose, however, that it is learned that gate crashers have made counterfeit passes and the guard is told that he must therefore attempt to size up each individual seeking entry to determine whether or not he is a musician.

The guard starts out with the initial assumption that the musicians will be carrying an instrument. This is not a sure criteria since the drummer and piano player will not, and some gate crashers may be carrying instrument cases.

But like the adaptive filter, the guard has a simple memory and he can make use of feedback.

He knows that each time he admits a person that is indeed a musician, he should hear one more musician tuning up on stage seconds later.

The first man to seek entry is carrying a black case and a pass, so the guard decides to risk admitting him. A few moments later he hears a trumpet player tuning up on stage and decides that he made a wise decision. Moments later another man appears with an instrument case and pass and the guard admits him. Shortly afterward the guard hears a violinist tuning up and decides that these two criteria—an instrument case and a pass—are the significant marks of a musician.

But next there appears a woman, also carrying a pass and instrument case, so the guard admits her. But he waits in vain for the sound of a third musician tuning up and finally decides he's been fooled by a gate crasher. He therefore modifies his admittance criteria to add the requirement that only males will be allowed entry. When a 12-year-old boy appears, with instrument and a pass, he meets the guard's revised admittance criteria and gains entry. But again the guard waits in vain for the sound of a third practicing musician and then decides the boy was another gate crasher. Again the guard revises his admittance criteria. This time he resolves to admit only adult males carrying instruments and passes.

Through this process of learning, and adapting, with the aid of feedback and memory, the guard soon develops an admittance criteria which enables him to discriminate between musicians and gate crashers with a moderately high degree of success. By a somewhat similar process, the adaptive filter learns to descriminate between noise which it should block and signals which it should pass.

characteristic, which makes the General Electric technique unusual.

If it were desired to pass signals of two or more different waveforms simultaneously, this could be done by using two or more self-adapting filters suitably interconnected.

Time to Adapt

The length of time required for the filter to recognize the presence of a signal and to adjust its response to match the signal, called "convergence time," depends upon several factors, including signal-to-noise ratio and signal repetition rate.

For the circuit configuration used in initial experiments, which does not represent the ultimate in sophistication or performance, company scientists obtained the following convergence times under the conditions indicated:

• **Four seconds** for a signal-to-noise (S/N) ratio of 20 at a pulse repetition rate of 45 per second, or for an S/N of 50 at a repetition rate of 18 per second. (Signal-to-noise ratio as used here equals twice the signal energy divided by noise per unit bandwidth.)

• **Eleven seconds** for S/N of 6 at a repetition rate of 45 sec., or for an S/N of 20 at a repetition of 18/sec.

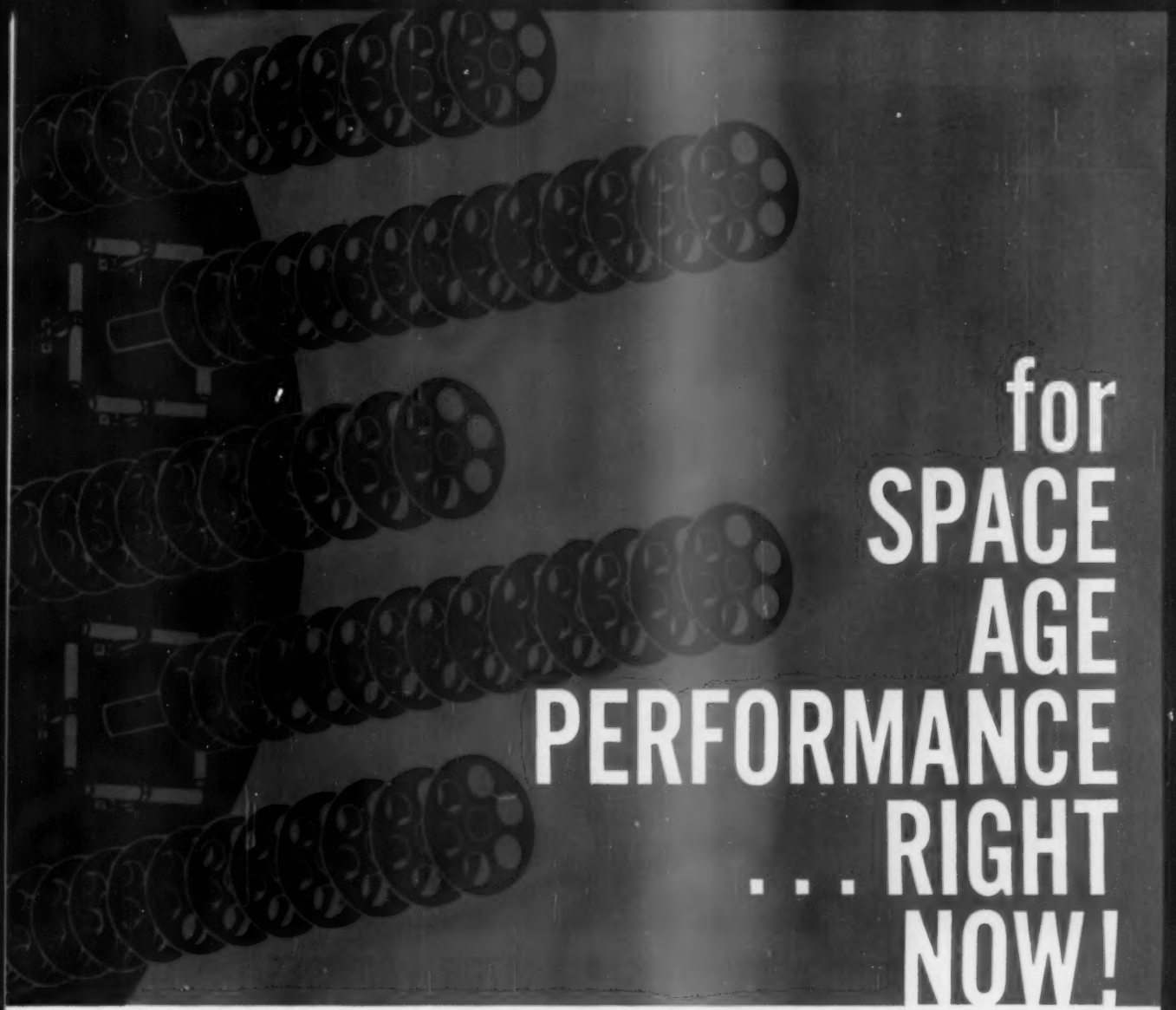
Principle of Operation

The self-adapting filter has a memory circuit in which it stores its current estimate of the significant characteristics of the incoming signal. This estimate of signal characteristic stored in memory gradually decays with time unless it is periodically reinforced. (In experimental filter, memory time constant was about 20 sec., but value would depend upon intended use.)

The filter continuously compares its memory's estimate of the incoming signal characteristics with the input to the filter. Where it finds reasonably similarity (correlation), the estimate of signal waveform stored in memory is reinforced.

When the input to the filter is solely Gaussian noise (no signal), the estimate of signal stored in memory is completely random like the noise. This means that there is no continuous or periodic correlation and therefore no effective reinforcement of signal estimate in memory.

But as soon as a signal appears at the input, in the form of a series of pulses of identical waveshape, salient features of this waveshape feed back to the memory. Now as the filter compares its memory's impression of the signal with successive pulses it finds similarity, or correlation. This results in further reinforcement of the estimated signal in memory. After the required convergence time of a few seconds, a moderately precise replica of the incoming pulse waveform has built up in memory and the



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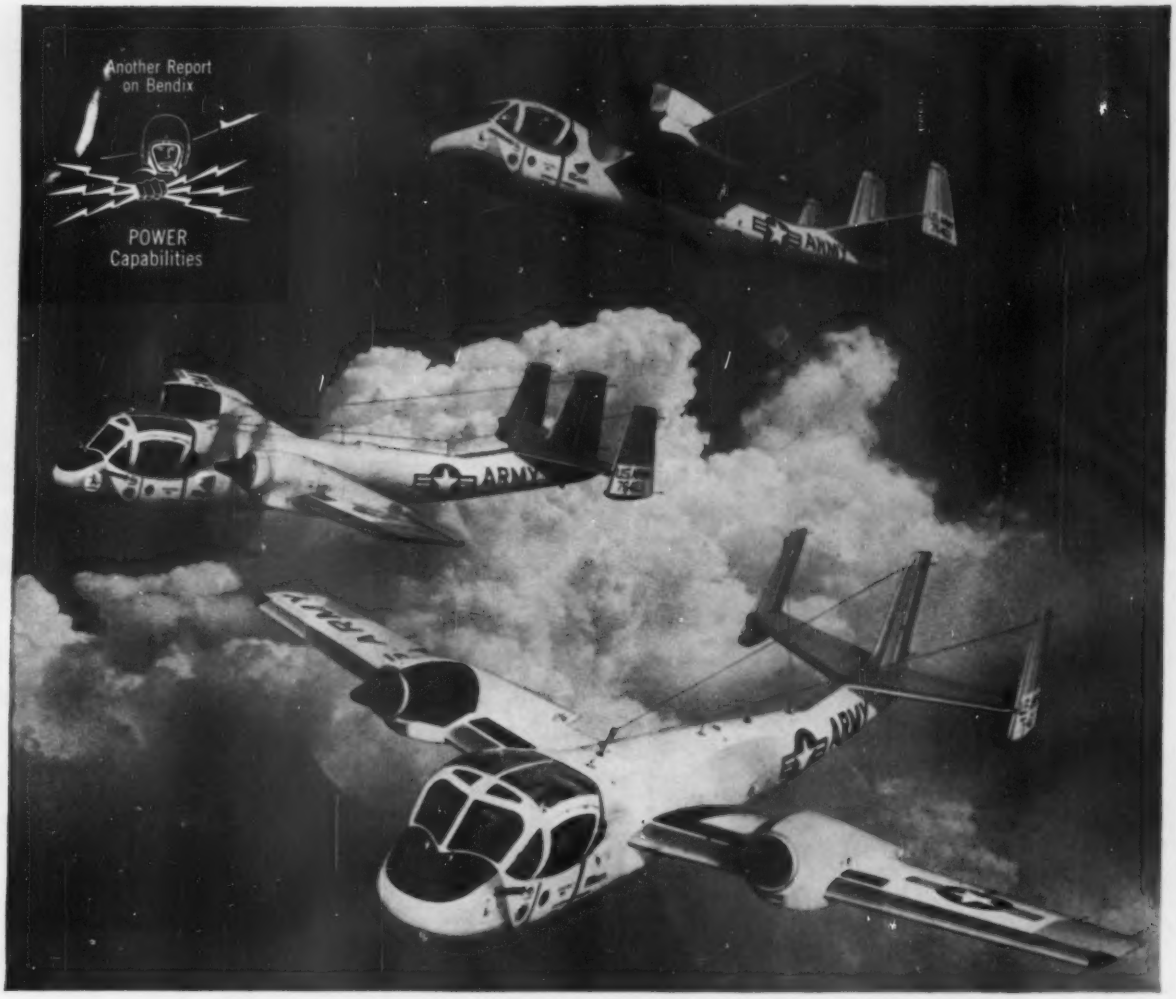

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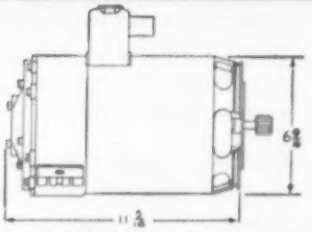

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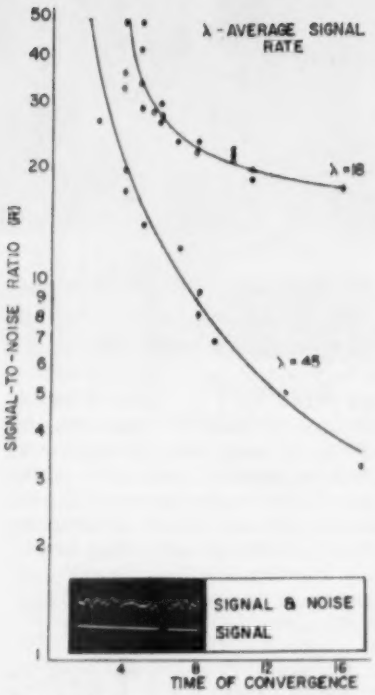

ADAPTIVE filter convergence time, required to detect signal and adjust to pass its waveform, in GE experiments using simple filter is shown as a function of signal-to-noise ratio for two different signal repetition rates, 18 and 45/sec.

filter now passes all such signals.

If the signal pulses should now stop, the replica of the signal stored in memory gradually decays until the memory returns to its original equilibrium state in which it contains only random noise.

If a signal of an entirely different waveshape should now appear at the input, the entire process is repeated with the memory building up a replica of the new signal waveform.

To prevent memory from building up so reinforced an image of an incoming signal that it requires too long to wipe it out when the signal disappears, the filter, in effect, slows down the process of memory reinforcement when a sufficiently accurate replica of the incoming signal has been built up.

Comparison of the similarity (correlation) of the incoming signal waveshape with the waveshape estimate contained in memory is made simultaneously at a number of different points along the waveform.

The number of such points of comparison is referred to as the system "dimensions."

To hold down system complexity during initial tests, General Electric used a 10-dimension filter, i.e., measurement of signal amplitude at 10 equally spaced intervals. This is accomplished by means of a delay line with 10 one-milli-

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Footnotes to the Crusader's 203,512th flight

This was a test flight for a new *Crusader* — the all-weather F8U-2N pictured here. It was a busy day for *Crusaders* all over the world. Over 700 of these carrier-based fighters have joined Navy and Marine squadrons since the first *Crusader* won the Thompson and Collier trophies. With the more powerful engine and armament, the advanced autopilot and radar of the new -2N, this fighter series is being improved for the third time at minimum cost and without interrupting Fleet readiness. This is "design growth." This is why, fighter for fighter, the *Crusader* has logged more peace-keeping flight hours than any other 1,000-plus-mph aircraft in U. S. service.

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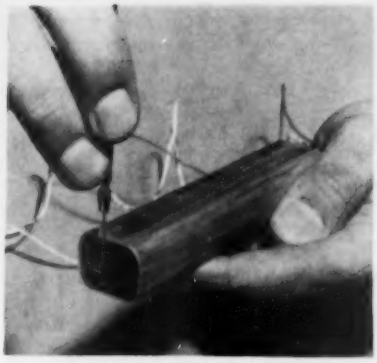

Silicon Radiation Detector

Silicon radiation detectors like this one (AW Feb. 15, p. 81) will check amount of radiation man may encounter in space during simulated space crew cabin experiments aboard forthcoming high-altitude balloon and Atlas missile flights. Detectors, made by Hughes Aircraft Co., recently were delivered to Air Force School of Aviation Medicine, Aerospace Medical Center, San Antonio, Tex. Pulses, emitted by the detector when struck by charged nuclear particles, are amplified, fed to telemetry system within space vehicle and transmitted back to earth.

second taps into which input feeds.

By going to a greater number of dimensions, it should be possible to make filter responsive to more complex waveforms and also perhaps to reduce convergence time. Scientists plan to experiment with systems of 100 to 500 dimensions using digital computer simulation to avoid complexity of constructing circuits with so many dimensions.

Outperform Humans

However, even with the 10-dimension system the new technique is able to outperform human observers. In these experiments, using an input with an S/N ratio of 10, the filter could detect presence of signal consistently. But human observers who knew the shape of the signal were unable to detect its presence about half the time, using both visual and aural means, GE reports.

Although an operating system probably would consist of several adaptive filters, the principle of operation can be explained on the basis of a single filter. Basic elements of the 10-dimension experimental circuit (see block diagram) include the following:

- **Temporary storage,** into which input feeds, consists of a tapped delay line. For the 10-dimension circuit used in General Electric experiments the delay line has 10 taps, each spaced one millisecond apart. Delay line is band limited to 500 cps.
- **Memory,** which consists of 10 capaci-

Aerotec BB-201 Flow Indicator

- *Actuates on decreasing fuel flow*
- *Discriminates between fuel and air*

Decreasing fuel flow will actuate this valve even though air is mixed in the stream. Installed in the fuel line between auxiliary and main tank in the Lockheed C-130B *Hercules*, this sophisticated unit gives the pilot positive indication when the tank empties, although the fuel pump may draw sufficient air through the line to prevent a conventional switch from functioning. The ability of the BB-201 to discriminate also makes it suitable for applications where gas flow in a liquid-gas mixture is to be monitored.

The indicator has a 5 amp 28 VDC capacity which permits automatic operation of pumps or control valves without relays. Phone or write Aerotec for more information about the BB-201 and other aircraft switches and controls.

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tors—one for each of the 10 elements of waveform to be stored. Each capacitor is shunted by a resistor whose value determines the decay time of signal replica stored in the capacitor memory.

• **Correlator,** which consists of 10 multipliers—one for each delay line tape and memory capacitor. Each multiplier takes the vector product of the value of input at its respective delay line tap and the signal replica stored in its respective memory capacitor. The outputs of the 10 multipliers are then added.

• **Threshold peak detector,** which compares the sum of the 10 vector products with a stored reference value to determine whether there is sufficient similarity between the input and the signal replica in memory. If the sum of the 10 vector products equals or exceeds the stored reference value, indicating similarity/correlation, the threshold peak detector activates the arithmetic unit.

• **Arithmetic unit,** when activated, causes the signal replica stored in the memory capacitors to be strengthened, or enhanced. This is accomplished by means of 10 additional capacitors, one for each tap on the delay line. Each of these capacitors is permanently connected to its respective delay line tap so that the corresponding element of input waveform is stored in the capacitor. When the arithmetic unit is activated by the threshold detector, indicating the presence of a signal, the value stored in each of these capacitors is transferred to its respective memory capacitor, thereby enhancing the signal replica previously stored there.

Value Increases

When the sum of the vector products equals or exceeds the reference value in the threshold detector and activates the arithmetic unit, the reference value in the threshold detector automatically is increased. In effect, this means that as the memory begins to encounter similarity with the incoming signals, and feedback enhancement results in building up a more accurate replica of the waveform of the signal in memory, the filter automatically increases its selectivity, demanding greater correlation between input and memory. If the circuit has indeed "discovered" the presence of a signal and has not been momentarily "fooled" by noise, there will be increasing correlation between input and memory necessary to activate the arithmetic unit despite the higher threshold value until an accurate replica of signal is built up in memory.

It is not necessary that the memory originally contain an accurate replica of the incoming waveform for the filter to start to adapt to a signal, i.e., initiate convergence. All that is required is that memory contain a component of the incoming signal.

The reference value in the threshold

at ground level or at 50,000 feet...

Pacific's AUTOMATIC ESCAPE/RECOVERY COMPONENTS

improve flight personnel safety!

...PACIFIC LITERALLY HELPS TO BRING THEM BACK ALIVE!

Escaping from a high performance airplane is a treacherous business under any condition. At 50,000 feet or more the pilot must reach a much lower altitude swiftly; at low altitudes a very rapid and closely controlled sequence of events must take place to deploy the pilot's parachute before he hits the ground . . . and at supersonic speeds the pilot must decelerate to a safe speed before separating from his ejection seat.

Providing escape capabilities to meet all of these conditions, even when the pilot is partially incapacitated, means that *automatic escape and recovery is a must.* To meet this challenge, Pacific Scientific has developed a complete series of products capable of reliable performance within the rigorous time-phase requirements dictated by such emergencies . . . no matter what the speed or altitude.

Each Pacific product shown here represents a major investment in design and testing to insure a highly reliable power package controlled by a precision instrument mechanism. Combining technical know-how in instrumentation with heavy experience in aneroid, spring and ballistic-actuated mechanisms has resulted in these proven devices which make reliable, automatic escape and recovery a reality.

Pacific Scientific's extensive experience can provide the solution to your problems.

BALLISTIC INERTIA REEL
Pacific's proven and highly reliable inertia reel concept has been incorporated into a new device that has the added capability of retracting the straps. When pilot actuates the pre-ejection system, a propellant charge—remote or integral—firmly positions the pilot for maximum safety in ejection.

SPEED SENSOR
This device continuously monitors the speed of the plane. Depending upon the speed at ejection, it selects appropriate ballistic time-delays to permit automatic lap belt and shoulder harness release.

SEAT SEPARATOR
Releasing lap belt actuates the seat separator which tightens a strap between pilot and seat. This acts as a "sling-shot" forcibly separating pilot from seat.

PARACHUTE RELEASE
At instant pilot and seat separate, the arming cable of parachute release is automatically pulled. If this occurs above pre-selected altitudes, the aneroid element will prevent parachute deployment until pilot falls to this altitude. If seat separation occurs below pre-selected altitudes, parachute deployment is instantaneous.

Write today for further information.

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Creative Manufacturing and Development of Flight Safety Equipment and Controls

READING AN INFERNO'S SECRETS...
Missile "silo" concept proved practical—
by Lockheed Electronics

The U.S. Air Force came to Lockheed Electronics with an extremely complex and urgent problem. Could the tremendous shock and heat of a missile blast-off be accurately measured in launchings from an underground silo?

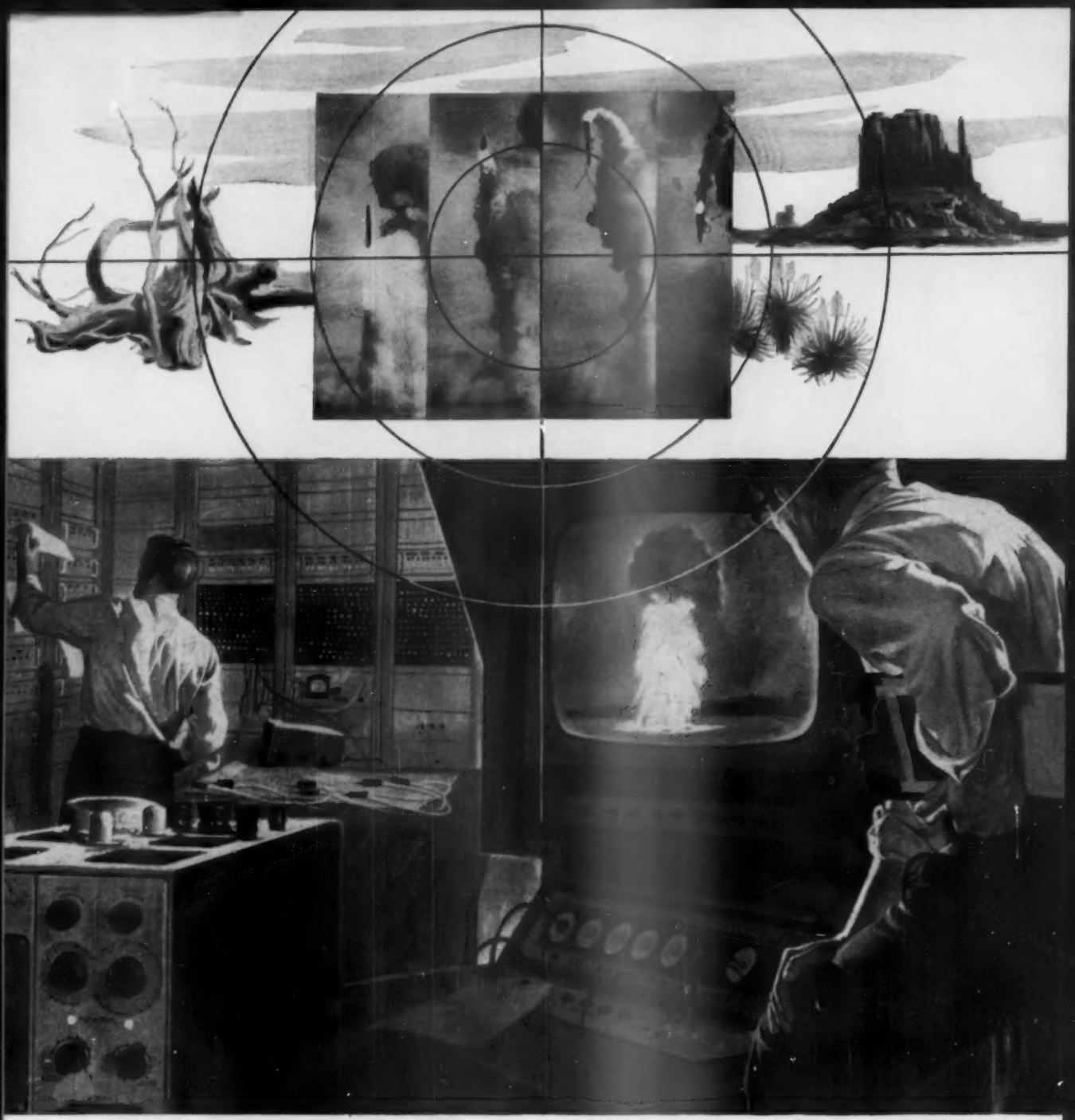
Lockheed Electronics designed and built a special data-gathering system to analyze, through instrumentation, the searing heat and violent shock of more than 40 test firings. During each test more than 200 measurements were made simultaneously.

Results have produced new understanding of missile stresses, acoustics, thermal radiation, shock and vibration. This vital information is already being applied to the design of "hard" launching sites.

The capabilities of Lockheed Electronics, Information Technology Division extend to all phases of data handling—a fact well worth remembering when you encounter tough problems in this field.

CAPABILITIES—INFORMATION TECHNOLOGY DIVISION

Data processing
Data storage • Telemetry systems
Data reduction and display
Special-purpose computers
Traffic control systems • Systems research



MINDING THE FUTURE

LOCKHEED ELECTRONICS COMPANY

INFORMATION TECHNOLOGY DIVISION, METUCHEN, N. J.

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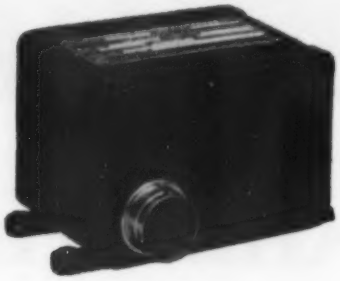
PRECISE ALTITUDE CONTROL

IN A 4-INCH PACKAGE

The new Daystrom Barometric Altitude Controller has unusually high frequency response to precisely position and maintain an aircraft or target drone at a constant barometric altitude—from below sea level to 125,000 feet. This 2¾ lb. unit is small enough to fit in the palm of your hand*...yet it has laboratory sensitivity that is better than 0.00036 psi! And simplified circuitry helps assure at least 1000 hours of reliable, maintenance-free operation.

At the heart of this instrument is Daystrom's unique null-balance pressure transducer. It provides unusual accuracy, simplicity and economy for a variety of airborne applications...another example of Daystrom's ability to create better instruments and systems in smaller, more economical packages for military and commercial use.

For complete information, contact your Pacific Division representative or write us for Data File AW-887-2.



*Dimensions:
2.75" high
4.00" wide
3.50" deep

Openings exist for qualified engineers

DAYSTROM, INCORPORATED
PACIFIC DIVISION
9320 Lincoln Boulevard, Los Angeles 45, Calif.

detector, which must be equalled or exceeded by the sum of the vector products, decreases in magnitude in the absence of an input signal as well as increasing in value when correlation is found. This means that if a particular input signal suddenly disappears, the threshold value decays to a very low value. This permits a random sample of waveform (noise) to be transferred into memory, returning it to equilibrium condition so it can respond to the same signal, if it reappears, or to an entirely different signal.

Slow Changes

This changing, or variable, threshold value means that the filter can adapt to slow changes in the waveform of a given input signal. This might offer attractive possibilities for encrypting communications with a time-varying code.

Although the present experimental filter employs only a single threshold detector for determining the presence of a signal and for determining when to reinforce the contents of memory, General Electric points out that it might be advantageous to use two separate threshold detectors, each set at a different value. The threshold detector value used to determine the presence or absence of a signal could then be set to provide any desired ratio of "hit" to "false-alarm" ratio.

The company's Dr. Shuey says that the new adaptive waveform recognition technique is not limited to use in low signal-to-noise situations. They were selected for experimentation because they pose the most difficult condition under which to initiate filter convergence. The new technique might also be used advantageously in high signal-to-noise situations where it is desired to sort and classify signals on the basis of their similarity in shape.

FILTER CENTER

▶ **Thermoelectric Efficiency Gains**—New thermoelectric material with extremely low thermal conductivity (0.0064 watts/cm.-Deg. C.) and a figure of merit (Z) of about 0.00175 per degree Centigrade over temperature range of 200-500C, has been developed by Bell Telephone Laboratories. Figure of merit is best yet obtained in a P-type thermoelectric material, BTL says. Material is a ternary intermetallic semiconductor compound consisting of silver, antimony and tellurium. Material exhibits P-type characteristics in its thermoelectric properties but shows N-type characteristics in its Hall effect coefficient under certain conditions.

▶ **Microminiature Amplifier Developed**—Tiny pre-amplifier measuring only 0.4 x 0.5 x 0.2 in., is small enough to be

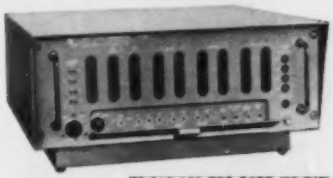
TIME TEAM

HOW EECo'S ALL-STAR LINEUP OF TIME CODE GENERATORS WINS ON EVERY POINT

Look at these unparalleled advantages offered by EECo Time Code Generators! Frequency stability, 3 parts in 10^8, based on extremely stable crystal oscillator. 100% plug-in circuits to keep generator working for you day in and day out. Emitter-follower low-impedance outputs for long-distance transmission. Wider operating-temperature stability. Operable from aircraft power. Provision for external frequency standard. Human-engineered. Check it all out and you must choose EECo!

ZA-801 BCD OUTPUT (24-BIT)
Time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. $7,650.
ZA-803 BCD OUTPUT (20-BIT) $7,925

ZA-802 BINARY OUTPUT (17-BIT)
Time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. $7,050.



ZA-810 100 PPS CODE (36-BIT)
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SEND FOR TIME CODE GENERATOR FILE 301

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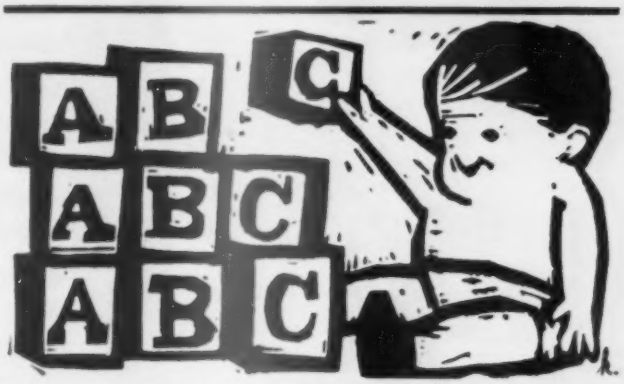
PROBLEMATICAL RECREATIONS 33



Find a number of the form aaabbbccc which gives, when increased by unity, a perfect square of nine digits. —*Mathematics Magazine*

The Tactical Systems Laboratory of our Electronic Equipments Division is currently developing systems for the Navy, Marines, and Signal Corps. They are doing so in new air-conditioned facilities in the Los Angeles suburb, Canoga Park.

ANSWER TO LAST WEEK'S PROBLEM: The 2nd wife underestimated her husband. She knew the first 14 eliminations would occur at positions 3, 7, 8, 9, 10, 11, 15, 20, 22, 23, 24, 26, 27 and 30, but he knew the first counted out of 16 would survive 15 eliminations.

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Beverly Hills, California

AT-THE-READY MISSILE SITE SUPPORT

WITH THE VERTOL 107

The Vertol 107, twin-turbine-powered helicopter, offers a new concept of dependability for all-weather, around-the-clock support of ICBM dispersed launching sites.

Under virtually every condition — including road-blocking storms, sabotage and enemy action — this advanced helicopter offers a most effective means of maintaining a continuous flow of essential men and materiel to remote missile launching sites.

For command inspection and high priority maintenance of missiles at scattered sites, the all-terrain Vertol 107 offers travel time reductions up to 90%. In addition, since personnel can be shuttled back and forth between home base and launching areas in minutes, the need for extensive housekeeping facilities at each site is eliminated. The Vertol 107 Model II can carry a 5,000-pound payload internally, externally — or, if necessary, half-in half-out — over a mission radius of 100 nautical miles — even on a hot day at 7,000-foot elevations.

The twin-turbine, tandem rotor Vertol 107 — the most advanced helicopter flying today — offers a new high in dependability for the Strategic Air Command.

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CONSISTENT RELIABILITY

in production-quantity **miniature** floated gyros

with trimmed drift rate of

ONE HUNDREDTH DEGREE per **HOUR**

Designed-in reliability and the most precise production techniques have combined to produce the new ZERO-ONE Gyro. The first in a new series of IFG-300 integrating floated gyros, the ZERO-ONE is a proud achievement in the long line of gyro developments by REEVES.

The combination of high reliability and extreme accuracy make the ZERO-ONE Gyro the ideal choice for guidance and stabilization systems where guaranteed performance is paramount.

For complete specifications, write for data file 308.

Qualified engineers seeking rewarding opportunities in these advanced fields are invited to get in touch with us.

TYPICAL SPECIFICATIONS

Trimmed Drift Rate: 0.01 degrees/hr

Angular Momentum: 300,000 c.g.s. units

Damping: 300,000 c.g.s. units

Nominal Signal Generator Sensitivity: 10 mv/mr @ 50 ma, 400 cps

Torque Generator Sensitivity Range: 0.05 to 3.0 degrees/hr/ma^2

Time Constant: As low as 0.4 msec.

Mass Unbalance: 0.4°/hr/g

Anisoelasticity: 0.003°/hr/g^2

Dimensions: 1.8 in. x 2.75 in.

REEVES INSTRUMENT CORPORATION

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7RV60

placed adjoining tape recorder heads to reduce hazard of stray pick-up. Developed by Halex, Inc., El Segundo, Calif., the micro-preamp contains two transistors, five resistors and three capacitors in a volume of 0.038 cu. in. Amplifier has frequency response from 200 cps. to 200 kc., provides 54 db. gain, with harmonic distortion of 0.5% and noise figure of 3 db., according to the manufacturer.

► **SAGE System for Space Proposed**—Global satellite tracking network, consisting of seven high-power radars and computers located along a great circle, capable of detecting and tracking earth satellites to keep a continuous catalog of all space objects, was proposed by Peter R. Dax, Westinghouse Electric, at recent International Astronautical Congress in Stockholm. Dax said that such a "Space SAGE System" will be needed within a decade when there may be 1,000 earth satellites in orbit.

► **RTCA to Hold Anniversary Meeting**—The silver anniversary meeting of the Radio Technical Commission for Aeronautics, to be held in Washington, D. C., Nov. 1-2, will feature four technical symposia. Subjects include instrument landing, collision avoidance, data transfer and reliability. Panel members will be drawn from U. S. and foreign government agencies and industry. Unusual feature will be an additional group, to be called "Devil's Advocates," whose assignment is to see that dissenting points of view receive adequate discussion. RTCA meeting will be held at the Sheraton-Park Hotel.

► **Non-Visible Transistors**—New diminutive transistors, so small they are not visible to the naked eye, will soon be announced by Pacific Semiconductors, already maker of the smallest commercial transistors with its pico line (AW Apr. 11, p. 94). First versions of the new transistors, as yet unnamed, will be electrical equivalents of the 2N706 and must be viewed under a microscope.

► **Ryan Continues to Diversify**—Ryan Aeronautical Co., San Diego, Calif., recently disclosed formation of a partially-owned subsidiary, Ryan Transdata, Inc., to specialize in design and development of data handling equipment. William G. Alexander, formerly general manager of the Stromberg-Carlson Division of General Dynamics, will be president of the newly-formed company.

► **Hawaiian Mercury Site Readied**—Construction of Pacific Missile Range instrumentation station at Kokee Park, Kauai, Hawaii, to be employed with NASA's Project Mercury is nearing completion. Station will have RCA FPS-16 radar, FRW-2 command transmitters

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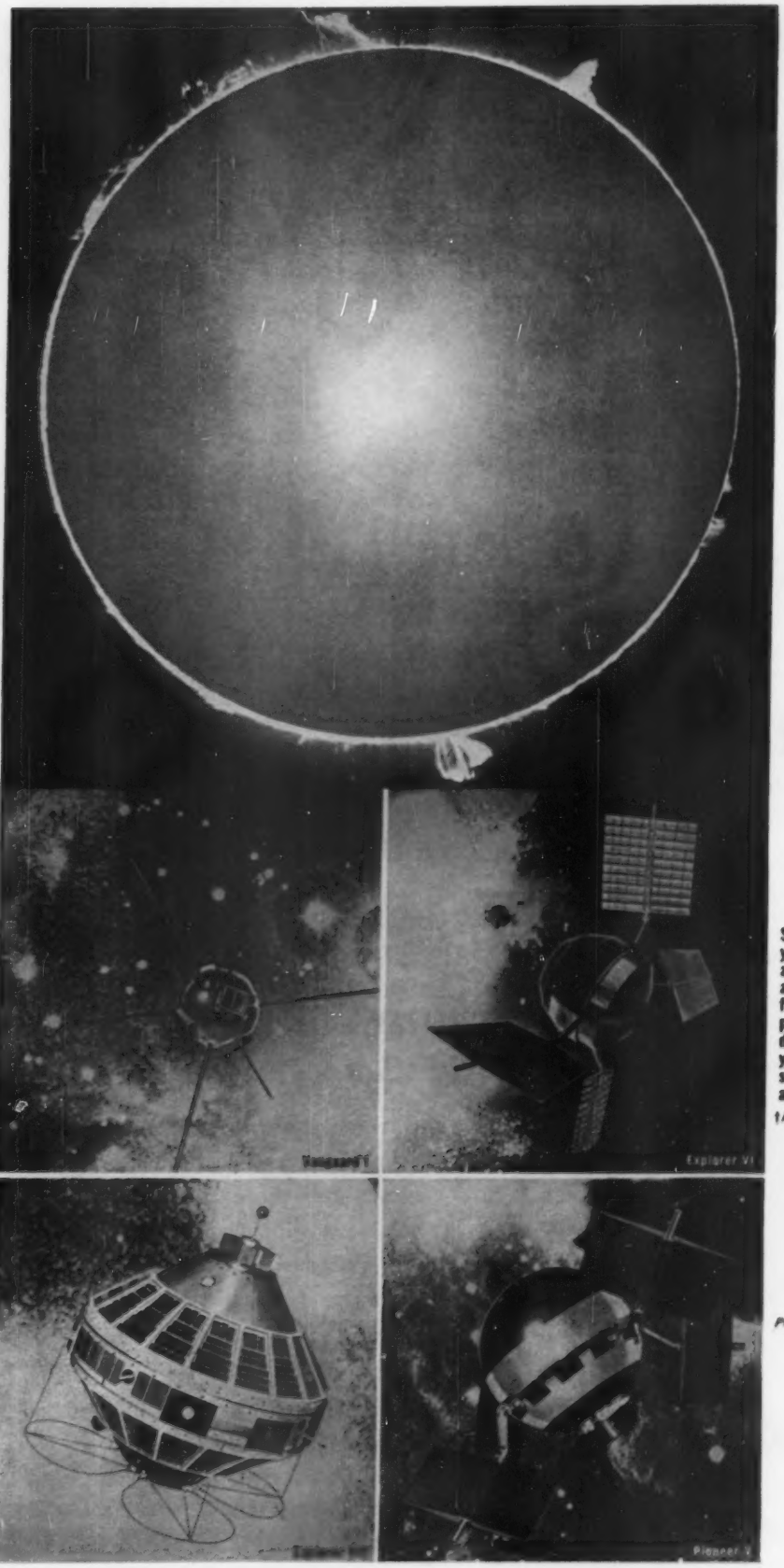
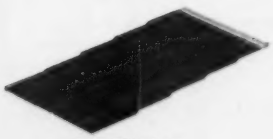
Lisle Magnetic Chip Detectors provide early detection of internal breakdowns, assuring constant protection against in-flight failure. Ferrous particles in a lubricant are a proven indication of excessive wear or impending breakdown. The Magnetic Chip Detector attracts these particles which bridge an electrically insulated gap in the Detector, completing a circuit which activates a warning light on the instrument panel.

Lisle Chip Detectors are used today in jet **and** reciprocating engines, accessory drives, propellers, constant speed drives and hydraulic systems in commercial and military aircraft.

LISLE CORPORATION CLARINDA IOWA *Write for Catalog and Samples for Testing*

Hoffman solar-power series.





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†A Patented Device (U.S. Patent No. 2,938,938)

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and other control-communications equipment, installation of which is anticipated in time for full checkout before first Mercury shot.

▶ **Signed On The Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Microwave Associates, Inc.**, Burlington, Mass., $91,000 Navy contract to survey phase-shifting techniques that show promise for electronic scanning radar antennas and to supply models of improved type phase shifters developed as result of the survey.

• **Sperry Gyroscope Co.**, Great Neck, N. Y., $2.2 million contract from Rome Air Development Center for development, fabrication and installation of AN/GSQ-44 nuclear detonation evaluation system.

• **Computer Systems, Inc.**, Monmouth Junction, N. J., $208,497 contract from Navy for missile range plotting boards. Plotting boards, to measure 45 x 150 in., will be installed at Pacific Missile Range command station to coordinate all firings.

• **Transco Products, Inc.**, Los Angeles, contract from North American Aviation for design and development of communications, navigation and identification antennas for the North American B-70. Devices will be required to operate at higher temperatures for longer periods than any previous aircraft antennas, company says. Company also reports contract from Navy Bureau of Weapons for research and development on high altitude, high temperature flush-mounted antennas for L-band, UHF communications and marker beacon receivers.

• **Federal Electric Corp.**, $196,490 contract from Rome Air Materiel Area, for operation and maintenance of Project Dewdrop tropospheric scatter communications terminal at Thule, Greenland. The tropo system provides communications link between Thule Ballistic Missile Early Warning System (BMEWS) and DEW Line rearward communications system at Cape Dyer, Baffin Island. Company says most of the employes at Thule will be Danish citizens.

• **Sylvania Electric Products**, subsidiary of General Telephone & Electronics Corp., $6 million Rome Air Materiel Area contract for intersite communications systems at Atlas missile bases in Wyoming and Kansas. Systems provide communications between Atlas squadron command posts and the missile launch sites. Company's Waltham Laboratories also report a $3.2 million contract for data processing equipment to direct movement of Navy's 600 ft. diameter radio telescope being constructed at Sugar Grove, W. Va.

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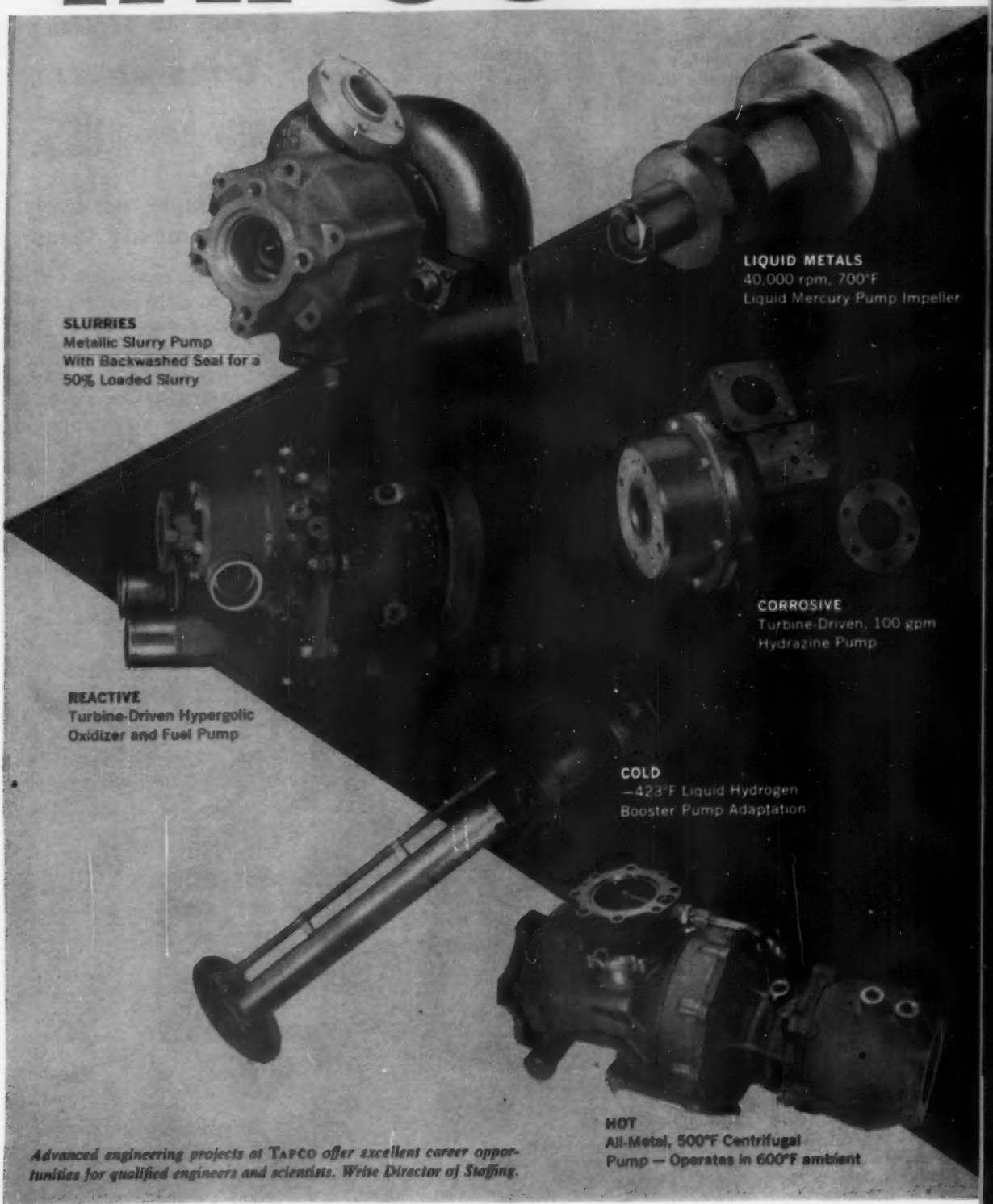

Advanced engineering projects at TAPCO *offer excellent career opportunities for qualified engineers and scientists. Write Director of Staffing.*

D SYSTEMS

Pumps for all Fluids

The TAPCO Group, the leading designer and manufacturer of fluid systems in the United States, has developed, built, and tested centrifugal pumps for all types of fluids. Six of these TAPCO pumps are illustrated at left.

These pumps, combined with other TAPCO fluid system components and accessories, provide completely integrated, single-source fluid systems at low cost, supported by TAPCO's excellent field service organization.

TAPCO's capability makes possible numerous new applications for booster pumps, including VTOL and STOL aircraft, ground effect vehicles, tanks, surveillance and observation equipment, jet-powered drones, and hydrofoils.

TAPCO GROUP
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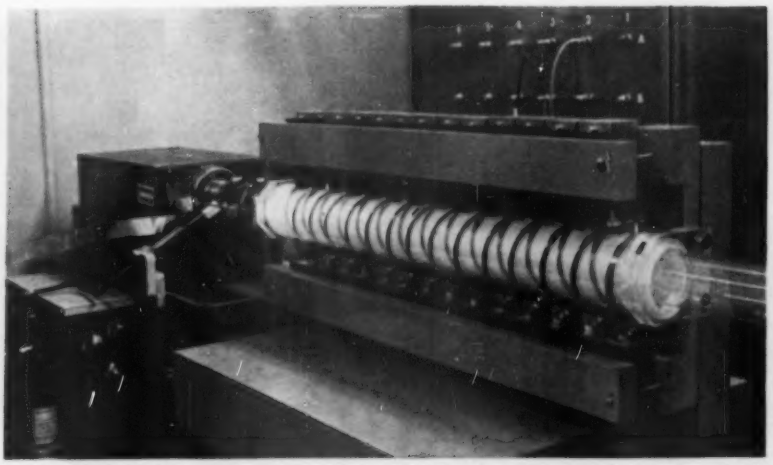

LABORATORY MODEL of an electrical magnetic induction plasma engine at Space Technology Laboratories glows faintly as it converts electrical energy into the power which might propel deep space probes.

STL Operating Lab Plasma Engine Model

Pasadena, Calif.—Laboratory version of a magnetic induction plasma engine which ultimately may be the simplest and most reliable electric rocket motor is now operating at Space Technology Laboratories, a technical meeting of the Advisory Group for Aeronautical Research and Development for NATO was told here recently.

Dr. Milton U. Clauser, vice president of STL, told the meeting which had convened to consider advanced propulsion techniques that all concepts associated with magnetic induction plasma engines are sufficiently well understood to permit development of engines suitable for deep space probes.

Hydrogen, deuterium and lithium are possible fuels for the space plasma engine, Clauser said. The first two would provide power rivaling that of the ion engine. The deuterium-fueled engine would be well suited for deep-space missions while lithium would produce enough power to make it attractive for the in-between region of satellites and spacecraft where chemical and ion engines cannot operate as efficiently.

Goodyear Completes Taxi Radar Unit

Technician inspects first production antennas for a new airport taxi radar system developed by Airborne Instruments Laboratory and made at Goodyear Aircraft Corp. in Akron, Ohio. System can detect aircraft and buildings up to a 4 mi. range. Reflector is made of Bondolite sandwich material with stretched aluminum face and aluminum honeycomb core and can rotate 360 deg. at 60 rpm. It will be installed at major U. S. airports.

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Reliability for Industry · Aircraft · Space Vehicles Cannon's full line of vibration-proof plugs are engineered to meet the most stringent demands of industry, missiles, and aircraft. If you have a problem in vibration, let us provide the answer. From umbilical plugs to the most versatile subminiatures... for any ground or airborne use, Cannon vibration-proof plugs surpass what is expected of them. Another reason why you should always consult the first name in plugs...why you should consult Cannon for all your plug requirements. For information on these or other Cannon products write to:

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What's missing in your Radar's Performance?

How can a radar operator *know* when system performance gets marginal? How can he assess the reliability of what he sees—not just in the prime performance area, but "out there" on the fringe of his radar's range?

The FAA signed a contract with Sperry to solve these problems, and the result is the new Sperry Radar Performance Analyzer. This instrument will find and analyze variations in transmitter power, receiver noise, tuning, sensitivity and subclutter visibility. It will spot performance deterioration and misadjustments on a continuous non-interference basis, indicating the moment-to-moment status of the radar.

One form of the Analyzer is being delivered for use with FAA surveillance radar at a number of airports. Other versions have been developed for missile guidance, tracking and search radars. Evaluation techniques employed are compatible with all modern radar techniques, such as pulse Doppler, MTI, pulse compression, frequency comparison. Whatever your system, the Sperry Radar Performance Analyzer will assure continued performance to spec, or rapid fault location minimizing system "down time."

Write for technical data or assistance.

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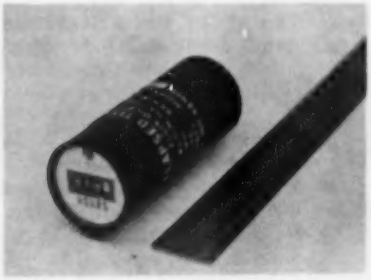
NEW AVIONIC PRODUCTS

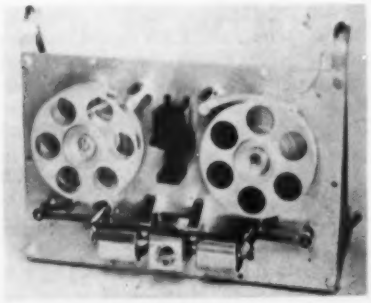
• **Flexible time delay relay,** providing delays either on operate or release ranging from 100 milliseconds to 60 sec., employs relay in combination with a transistorized gate circuit which is energized from a resistor-capacitor timing network. Accuracy is established by regulated power applied to timing unit. Input voltage is 21-30 vdc. Complete unit weighs 6 oz., can withstand 15g vibration through 2,000 cps., and 50g shock, according to manufacturer: Leach Corp., Controls Division, 5915 Avalon Blvd., Los Angeles 3, Calif.

• **Miniature elapsed time indicator,** measuring only 0.68 in. in diameter, 1.7 in. long, weighing 1.6 oz., provides digital read-out in 0.1-hr. increments for 1,000 hr. total of 1-hr. increments for 10,000 hr. total. Readout numerals



are 0.08 in. high, approximately the size of typewriter characters. Indicator is available for operation from 28 vdc. or 115 vac., 400 cps. Manufacturer: Elgin Micronics Div., Elgin National Watch Co., 336 Bluff City Blvd., Elgin, Ill.

• **High-speed punched tape reader,** employing optical canning system, is capable of stopping on character at normal tape reading rate of 200 eight-bit characters per second. Device has capacity of 550 ft. one-inch wide Mylar paper tape. Normal tape reading speed is 20 in./sec., with fast reading rate in both directions of up to 1,400 characters per second. Device measures 9 x 11 x 17 in., weighs 50 lb., operates from 120 vac., 60 cps. Manufacturer:



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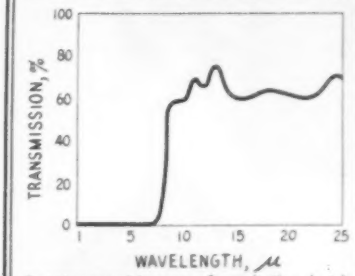

Spectrographic scan of production batch #1608. Side band attenuation: < 1%; pass region average transmission: > 60%; cut-on placement range available; 1.5 μ to 8.0 μ.

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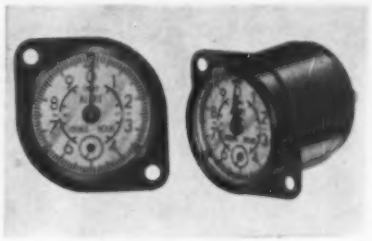
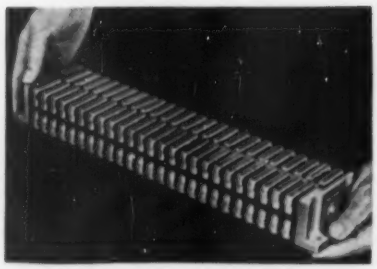


hr. models, the indicator can provide test records or operational life warning for components, modules or systems. It weighs 2 oz., max., measures 1 in. diameter by 1¼ in. in length and operates from 20 to 30 v.d.c. Houston Fearless Division, 11800 W. Olympic Blvd., Los Angeles 64, Calif.

• **Faraday rotation circulators,** Models CK 100, CKU 100, CX 100, CXL 140 and CXB 140, have vswr of only 1.3 max. on all ports and produce 15 db. of isolation min., 0.4 db. max. insertion loss. Frequency ranges in kmc. for the five indicated models in order are 22.5 to 25, 13 to 14.5, 8.5 to 9.8, 7.4 to 8.4 and 5.4 to 5.9. Rantec Corp., Calabasas, Calif.

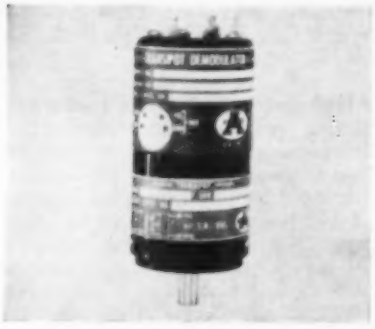
• **High-voltage silicon rectifier columns** capable of delivering up to a kilowatt of power per cubic inch of volume and suitable for long range radar applications are being made available for voltages ranging from 10,000 to 120,000 v. with current capacity from 1 to 50 amps. Rectifier columns employ modular design to optimize power per unit volume and provide ruggedness and reliability. Basic rectifier column module is a polyester glass board containing two rectifier cells, voltage dividing circuitry and heat dissipating shield. A standard one hv column comprises 50 of these modules mounted on an 18-in. central



beam. Capacitance to ground and series inductances are kept low, definite and equal. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

• **Varactor diodes,** Types XD 501 through 503, capable of unusually high-frequency operation, have been added to a line of diffused gallium arsenide mesa microwave varactors. The XD 503 has rated maximum cutoff frequency at breakdown of 310 kmc. Total capacitance range for the series is 0.5 pico farads min. to 1.4 pico farads max. and series inductance is kept down to 0.7 nanohenries at 9.4 kmc. Diodes are packaged in double-ended beryllium oxide cartridges. Texas Instruments, Inc., P. O. Box 312, Dallas 21, Texas.

• **Transducers,** Models 15-R-60-1-D and 15-R-30-1D, are d.c. output model additions to company's line of Transipot linear and rotary motion transducers. Both models accept standard size 15 servo mountings, are designed for 400 cps. power, and are capable of operating at frequencies between 300 and 3,000 cycles with modified input voltage. First model has input range of ±

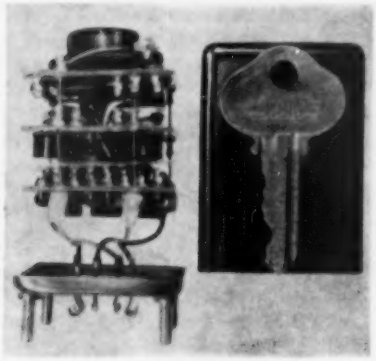


60 deg. and transfer sensitivity of 0.35 v. rms/deg. while second model has ± 30 deg. input range and 0.7 v. rms/deg. transfer sensitivity. Each model includes demodulator circuit for d.c. output which eliminates diode threshold problems. This provides sharp null with fine linearity about null point and absolute zero output at null point, according to manufacturers, Arnoux Corp., 11924 W. Washington Blvd., Los Angeles 66, Calif.

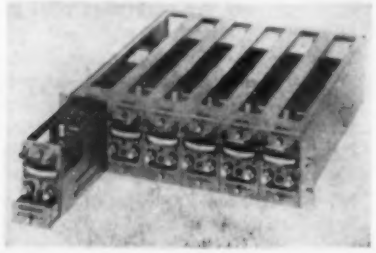
• **Miniature free gyros,** FM10 and FN30 series, developed and tested for

aircraft, missiles and drones are said to combine small size, low weight and high performance. Cageable FN 30 is two-axis, miniature free gyro with a.c. or d.c. motor and is available with outer gimbal synchro pickoff, potentiometer pickoffs on both axes, or potentiometer pickoff on the inner gimbal and synchro pickoff from outer gimbal. FM10 is two-axis miniature free gyro with synchro pickoffs and torques on both gimbal axes. Both series provide 10g vibration resistance and have gimbal inertia to angular momentum ratio of 1.3 x 10^6 gm.-cm.^{2}/sec. wheel with rigid gimbal structure for high performance. Daystrom, Inc., Pacific Division, 9320 Lincoln Blvd., Los Angeles 45, Calif.

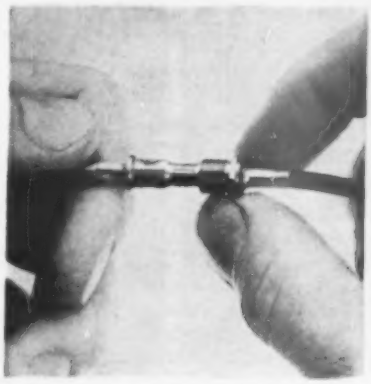
• **Static relay,** SR-101-1A, with modular construction, is designed for high reliability in space and airborne vehicles. Rated lifetime is a minimum of one million cycles. The solid-state relay will withstand 100g shock and 30g to 2,000 cps. vibration. It weighs 10 oz. max., will operate and release in approximately 10 and 50 microsec., respectively, has operating current at operating voltage of 60 milliamps., max. operating voltage of 30 v.d.c., pick up voltage of 16 v. ± 2 v. and drop out voltage of 9 v + 2 − 1 v. Controls Division, Leach Corp., 5915 Avalon Blvd., Los Angeles 3, Calif.

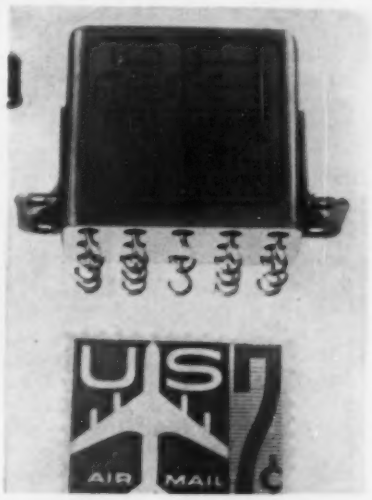


• **Telemetering subcarrier discriminator,** Model TDA-300, employs modular construction and advanced design techniques to occupy minimum of front panel space. Six units, each 5¼ in. high and 2⅛ in. wide, can be installed in a 19-in. rack. Power consumption is 30 w. at 115 v.a.c., input range is 60 db, 10 mv. to 10 v. (no input potentiometer), output stability is ± 0.25% after 10 min. warmup. Bendix Corp., Bendix-Pacific Division, 11600 Sherman Way, North Hollywood, Calif.

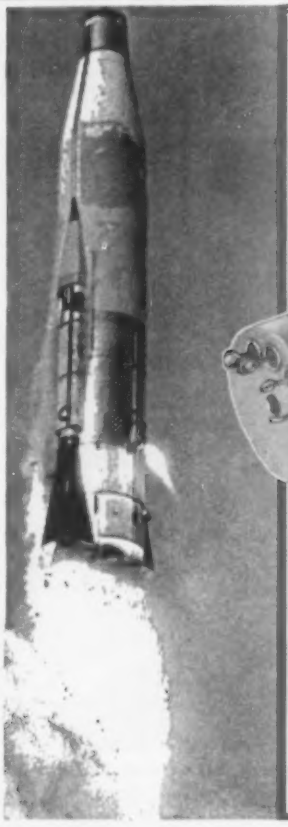


• **Coaxial connectors,** completely solderless, are available in a variety of mounting configurations, including snap locking versions. Male and female connectors can be mounted interchangeably. Mated length is 1⅛ in., working voltages are 1,000 v. max. at sea level, 500 v. max. at 60,000 ft., and vswr is less than 1.2 up to 2 kmc. Rated life is 5,000 matings/min. without electrical deterioration. Hard gold-plated beryllium copper and TFE plastic provide optimum reliability. Thirty day delivery. Microdot, Inc., 220 Pasadena Ave., So. Pasadena, Calif.





• **Subminiature four-pole relay,** double-throw, measuring approximately 0.6 x 1.0 x 0.925 in., weighing 1¼ oz., has contact rating of 2 amp. at 28 vdc. or 115 vac. Operating temperature range is −65C to 125C. Unit can withstand 30g vibration at 2,000 cps. and 50g shock. Manufacturer: Leach Corp., Relay Division, 5915 Avalon Blvd., Los Angeles 3, Calif.



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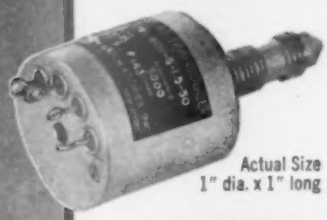
SMALL SIZE ONE CUBIC INCH MAX.
MINIATURE PRESSURE TRANSDUCER
SERIES 401



Actual Size
1" dia. x 1" long

High vibration performance
±35G to 5,000 cps
Pressure ranges
Absolute, differential and gage pressures
0-1 to 0-400 psi
Differential pressures
±3 to ±200 psi

Standard Nominal Potentiometer Resistances
400 to 10,000 ohms
Electrical Connection
Pigmy receptacle or soldering terminals
Mounting
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Arc Wind Tunnel Simulates Re-Entry

Palo Alto, Calif.—A prototype rotating arc wind tunnel to provide a continuous contamination-free stream of gas for simulating re-entry conditions of 20,000 fps. and 15,000F for extended periods has been developed by Vidya, Inc., subsidiary of Itek Corp.

The unit has been successfully developed to deliver gas streams with specific enthalpies in excess of 10,000 Btu./lb. at pressures as high as 400 psia. and at flow rates of the order of .001 to 0.1 pps.

The Vidya tunnel ensures steady-state conditions by extended test durations which have run as high as four minutes. Power input for the prototype tunnel ranges from 1.4 to 1.5 megawatt, although models can be designed for a variety of power inputs depending on customer needs, according to Vidya.

In addition to variable conditions of stream enthalpy, the unit provides a wide, controllable range of Mach and Reynolds numbers.

For arc-heating, the tunnel uses an electrode which consists of a pair of concentrically positioned, water-cooled, copper rings located between the pole faces of a circular electromagnet. The arc, initiated by the explosion of a 3 mil tungsten wire between the cathode and anode, forms in an annular gap between the outer cathode and inner anode.

Rotating-Arc Plasma Generator

Chamber pressure psia.	15	250	500
Air Flow lb./sec., Nozzle A	0.38	0.45	0.49
" " " Nozzle B	0.030	0.047	0.056
Air enthalpy Btu./lb. Nozzle A	1,000	1,000	1,000
" " " Nozzle B	10,000	8,000	7,000
Power to air, Btu./sec. Nozzle A	380	450	490
" " " Nozzle B	304	375	390
Efficiency, per cent, Nozzle A	50	30	25
" " Nozzle B	40	25	20
Arc voltage drop	180-220	360-430	460-550
Power to arc, Btu./sec.	680-840	1,360-1,630	1,750-2,090

The arc is driven by a magnetic field, at right angles to it, at high rotational velocities around the annulus. The incoming air, or other gas, is heated by passing through this annulus on its way to a plenum chamber prior to entering the tunnel nozzle. Measuring some 6,000 Gauss, the magnetic field is produced by water-cooled d.c.-excited coils located within the iron electromagnet.

Vidya reports that contamination of the stream due to erosion of the electrodes is avoided by cooling the electrodes and by the spinning of the arc—an action which eliminates burnout occurring if the arc stays too long on any single point of the material. Cumulative testing times of 20 to 30 min. caused no discernible loss of electrode.

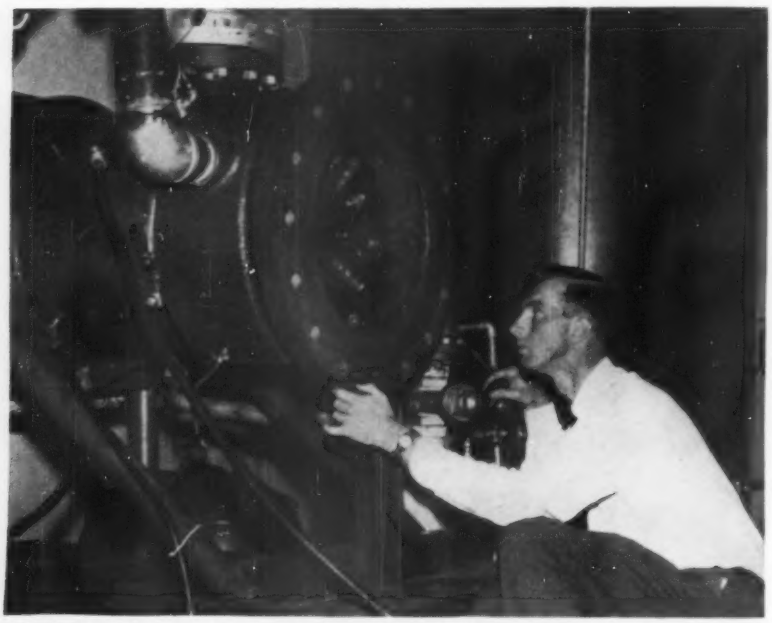
The tunnel consists of a high pressure steel shell, approximately 2 ft. in diameter by 3 ft. long, which contains a plenum chamber, the electrodes, magnet and nozzle. Upon leaving the nozzle, the hot, high-speed jet exhausts into a low-pressure test chamber which is instrumented.

The entire high-pressure chamber is under the stagnation pressure prescribed for the run. Water enters and exits through two separate jacket manifolds and is circulated to components by high-pressure hoses. The unit is designed for an input water flow of 200 gpm. to the manifold at 300 psi.

Designed under company funds, the arc-tunnel was devised as a research tool to provide a clean, hyperthermal environment for conducting hypersonic, aerothermodynamic and materials investigations on a continuous, steady-state basis. In addition to providing a testing facility for missile and space vehicle designs, the tunnel can serve as a tool for experimental research into plasma physics. Using gases other than air, the tunnel also can simulate various rocket and propulsion problems.

Vidya is currently designing and fabricating a similar arc-tunnel for a major industrial firm, and is performing contract-sponsored research on methods for improving the performance of certain components of the unit.

The company is also building instrumentation for measuring various properties of the high-temperature environment and, under contract with NASA, is developing a densitometer—a device for measuring local rather than average density of X-ray radiation in a gas stream.



INSPECTION for water leaks prior to operation of Vidya arc-heated wind tunnel is made by engineer Glenn Tickner. Tunnel provides wide range of Mach and Reynolds numbers.

CAPSULE designed for three men is shown in artist's conception at left. Space station and winged re-entry vehicles are at top and below. At right is double wall test specimen.

Aeronutronic Studies Three-Man Space Vehicle for Long Orbits

Newport Beach, Calif.—Promising structural configurations for "very advanced Air Force vehicles" are being studied at Ford Motor Co.'s Aeronutronic Division here under a $161,000 18-month guideline study contract awarded by USAF's Wright Air Development Division (AW Sept. 19, p. 39).

The study is concerned with the structure of a three-man vehicle that would orbit the earth at various altitudes for extended periods of time. A stiffened cylindrical shell of double wall construction has been designed by Aeronutronic's Space Technology Operations Group as a primary structure.

Pressure Vessel

Advantages of this type of structure are that it could withstand the mechanical loads imposed by launching it into space and also serve as a pressure vessel, a shield against cosmic and solar radiation and protect a crew from small meteorite impacts. The space between the walls would provide chambers through which various gases could be pumped to maintain environmental temperatures within limits.

The structure under study is 15 ft. long with an inside diameter of 7 ft. Provisions are incorporated for a "storm cellar," a highly secure area providing complete shielding from cosmic radiation. Interior also is compartmented for crew safety if the shell was penetrated by a meteorite.

A major problem at this time is the establishment of shielding requirements, according to Dr. Seymour Lampert, head of the aeromechanics activity, because of a lack of information on cosmic radiation intensity and the extent of human tolerance to radiation dosage. Available information indicates that a structure sufficient to protect against meteorite penetration will provide adequate shielding against electrons of the observed energy levels. However, there is concern over shielding against radiation generated by solar flares which contain particles of billions of electron volts of energy.

Capsule Shielding

Shielding against a proton of one billion electron volts (BEV) requires 22 in. of lead. "In stopping the original particle of energy, other kinds of particles and radiation are created which continue to penetrate the shield," Dr. Lampert said. "So something in excess of 22 in. of lead would be required to shield a human occupant against BEV protons."

The probability that a major solar flare will occur at any particular time is not well known, although they have been observed on the order of about two a year. If information becomes available so that solar flares can be predicted, launches can be timed to avoid them or warning from the ground could permit a crew to return to earth or ride out the radiation in the "storm cellar" which would provide some measure of protection.

Report Criticizes Atomic Planning

Washington—Primary management problem in the U.S. atomic energy program is the lack of sufficient long-range planning to move promising concepts and ideas from the basic research stage into full-scale development programs, the subcommittee on research and development of the Joint Congressional Committee on Atomic Energy said.

In a report titled "Frontiers in Atomic Energy Research," the subcommittee said the principal long-range planning problem is the "selection of projects" and said an atmosphere must be created, "in which the seedling projects of faraway applications can compete effectively with the pressures, schedules and requirements of short-range urgent work."

In essence the subcommittee called for a greater volume or more lucid public information on the atomic energy

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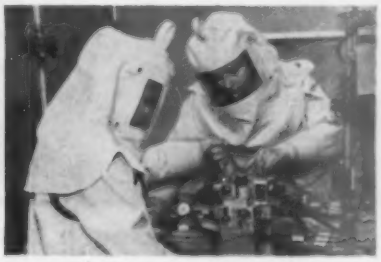
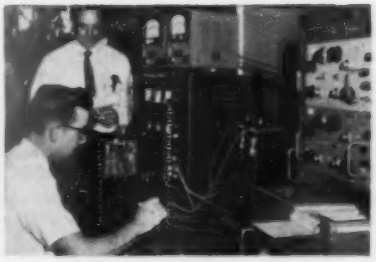
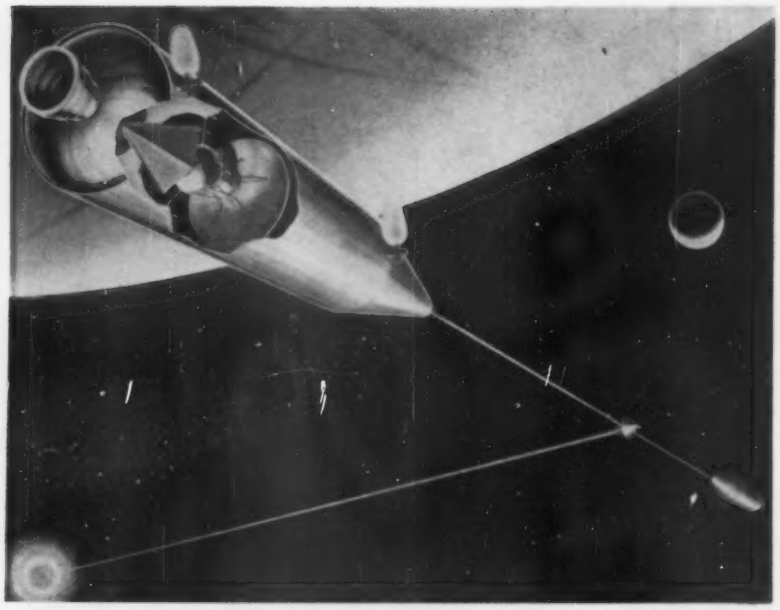
ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, 880, B-70 are important aspects of Hamilton Standard diversification.



ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.



ELECTRONICS at Hamilton Standard includes broad experience in flight control, instrumentation, static power inversion and electrical control for aircraft, missile and GSE components.



Lockheed Scientists Envision Mars Vehicle

Manned flights to Mars and Venus during the 1970s are envisioned by scientists at Lockheed Missiles and Space Division at Palo Alto, Calif., utilizing a vehicle such as is depicted above. Chemical rocket boosters needed to reach interplanetary flight speeds would be used as part of the space vehicle and payload for the flight—including life support systems—would be carried with the booster fuel tanks, supported on the rocket motor structure. Two booster rockets, which would be refueled by other identical boosters, would be fired into earth orbit, carrying crew and payload. Once on course for Mars in parallel flight paths, the two rockets would be strung together by a half-mile-long cable. Maneuvers would be produced by using small vernier rockets.

program, because it sees the solution to the long-range planning problem as a continuing review of the best technical opinions of the atomic scientists by the Congress, the executive branch and the public.

This review is intended to develop perspective, and judgment in these three bodies regarding the potential of atomic energy.

Some of the potential atomic energy projects listed by the subcommittee report which have been declared feasible for sometime by nuclear scientists are production of chemicals, recovery of minerals, construction of large underground boilers with very high available energy, excavation, construction of dams and irrigation canals.

The only advance projects with space potential discussed were those already being pursued, such as Rover, Snap and controlled fusion. Controlled fusion is still considered many years away from hardware development but it has the potential of producing the first high thrust, very high specific impulse rocket engine and essentially would combine the best features of the Rover thermo-nuclear rocket and an ion engine.

Ranking just behind a greater awareness of what technical opportunities lie ahead, the subcommittee believes, is a need for Congress, the executive branch and the public to revise quickly the traditional method of financing government agencies on a yearly basis.

In its review of atomic energy research, the subcommittee found that one of the greatest problems "was the need for long-term assurance of funding of promising projects, rather than year-to-year budgeting."

General funding level of the atomic energy program was considered adequate by the subcommittee, with the Rover project being the major exception. The Rover project is a "later stage of development" and requires large outlays of money immediately to take advantage of the technical progress which has been made with the nuclear rocket concept.

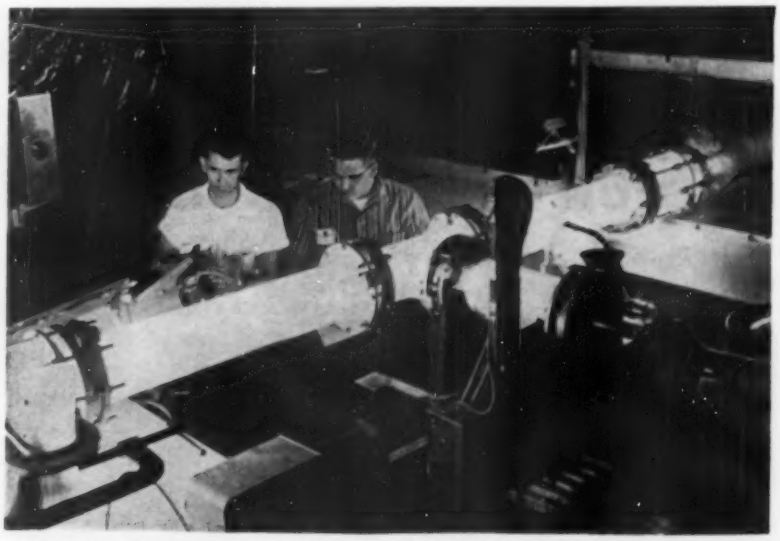
Apollo Bid Conference Attended by 88 Firms

Washington—Wide cross-section of industrial and research organizations was represented at recent briefing for prospective bidders for study contracts on the multi-man Project Apollo system (AW Sept. 19, p. 38).

Most major airframe manufacturers were among 88 firms attending the conference. National Aeronautics and Space Administration will receive bids until Oct. 10, and a selection board will name two or three firms to receive study contracts about Nov. 14.

Firms represented at the conference were:

Aerojet-General Corp., Aerolab Development Co., Aeronca Manufacturing Corp., Aeronutronic Division of Ford Motor Co., AiResearch Division of Garrett Corp., Allied Research Associates, Inc., Amcel Propulsion, Inc.; American Bosch Arma Corp., American Machine and Foundry Co., Armour Research Foundation, Avco Corp., Baldwin Lima Hamilton, Battelle Memorial Institute, Bechtel Corp., Beech Aircraft Corp., Bell Aerosystems Co., Belock Instru-



Shock Waves Reach Mach 80 Speeds at Impact

Collision of two shock waves traveling at Mach 80 speeds lights up this hydromagnetic shock tube at Boeing Airplane Co. Inititally, the waves travel at Mach 300 and are slowed to Mach 80 at impact. Tube is made of heat-resistant glass and uses liquid nitrogen poured into a vacuum line to help obtain a very low vacuum in the tube.

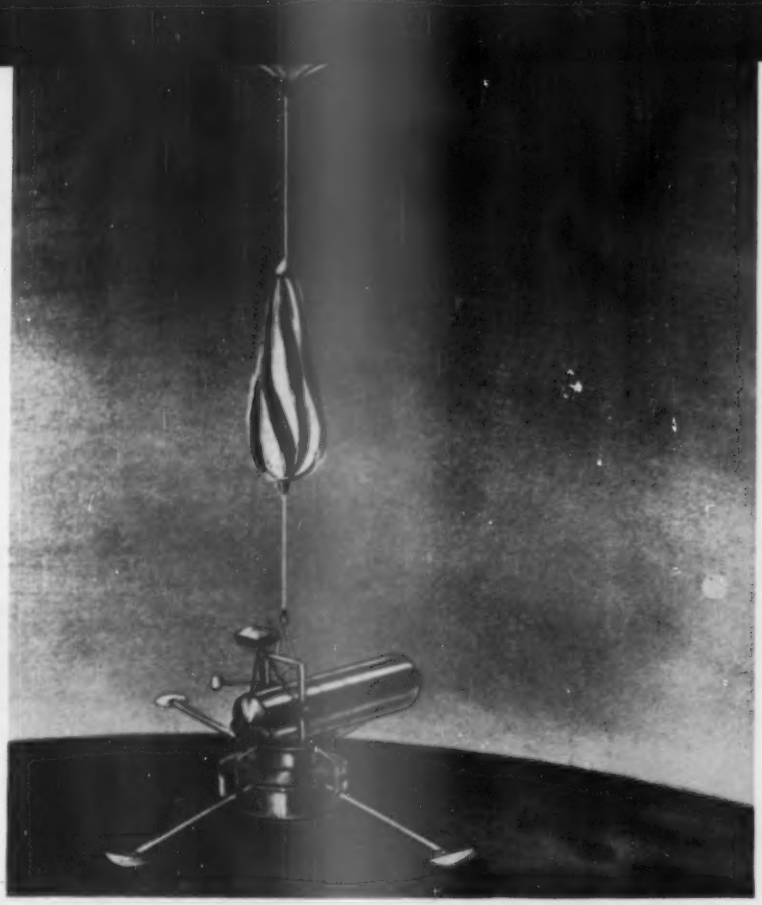
ment Corp.'s Astrospace Labs, Inc., Bendix Systems Division, Boeing Airplane Co.'s Aero-Space Division, Burns and Roe, Inc., Burroughs Corp., CBS Laboratories Division of Columbia Broadcasting System, Inc.

Also, Chance Vought Aircraft, Inc.'s Vought Astronautics Division, Chicago Aerial Industries, Inc., Chrysler Corp.'s Missile Division, Cleveland Pneumatic Industries, Inc.'s Instrumentation and Control Division, General Dynamics Corp.'s Convair Division, Cook Electric Co.'s Technical Center Division, Cornell Aeronautical Laboratory, Inc., Curtiss Wright Electronics Division, Douglas Aircraft Co., Fairchild Camera and Instrument Corp.'s Dumont Military Electronics Organization, Electro Mechanical Research, Inc., Electronic Communication, Inc.'s Marketing Dept., Emerson Electric Manufacturing Co., Fairchild Aircraft and Missiles Division, and Franklin Institute.

Also, General Electric Corp., General Mills, Inc.'s Mechanical Division, General Motors Corp.'s AC Spark Plug Division, General Precision, Inc., Goodyear Aircraft Corp., Grumman Aircraft Engineering Corp., Guardite Co.'s Space Technology Division, Gulton Industries, Inc., Hazeltine Corp.'s Electronics Division, Hoffman Electronics Corp., Hughes Aircraft Co., International Business Machines, International Telephone and Telegraph Laboratories, Litton Systems, Inc., Lockheed Aircraft Corp.'s Missiles and Space Division, Raymond Loewy Associates, Martin Co., McDonnell Aircraft Corp., Midwest Research Institute, and Minneapolis-Honeywell Regulator Co.'s Aeronautical Division.

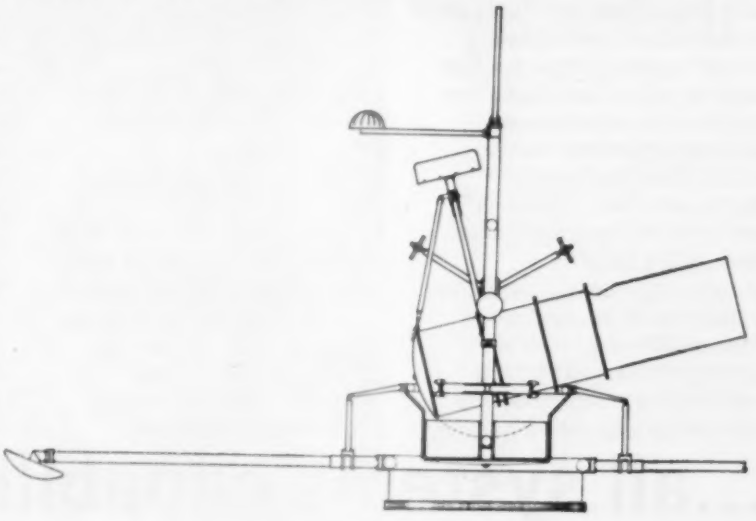
Also, National Cash Register Co., North American Aviation, Inc.'s Los Angeles Division, Northrop Corp.'s Norair Division, Philco Corp., Pratt & Whitney Aircraft Division of United Aircraft Corp., Radiation, Inc., Raytheon Co.'s Airborne Equipment Operations, Radio Corp. of America's Astro Electronic Division, Reed Research, Inc., Reeves Instrument Co.'s Dynamics Corp., Republic Aviation Corp., University of Minnesota's Rosemont Aeronautical Laboratories, Ryan Aeronautical Co.'s Electronics Division, Scientific Planning Associates Corp., Servo Corp. of America, Space Electronics Corp., Space Technology Laboratories, Inc.'s Contracts Operations, Spartan Corp.'s Electronics Division, and Sperry Rand Corp.'s Sperry Gyroscope Division.

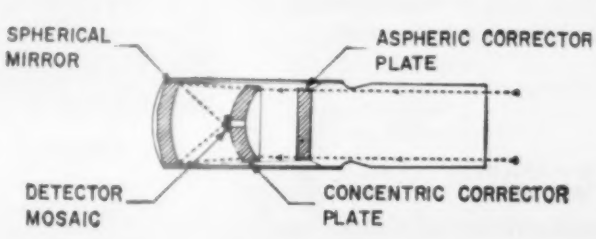
Also, Stanford Research Institute, Stanley Aviation Corp., Stromberg Carlson Co., Sun Electric Corp., Sylvania Electric Products, Inc.'s Electronic Systems Division, Thompson Ramo Wooldridge, Inc.'s Tapco Group, United Aircraft Corp., Missiles and Space Dept. of Hamilton Standard



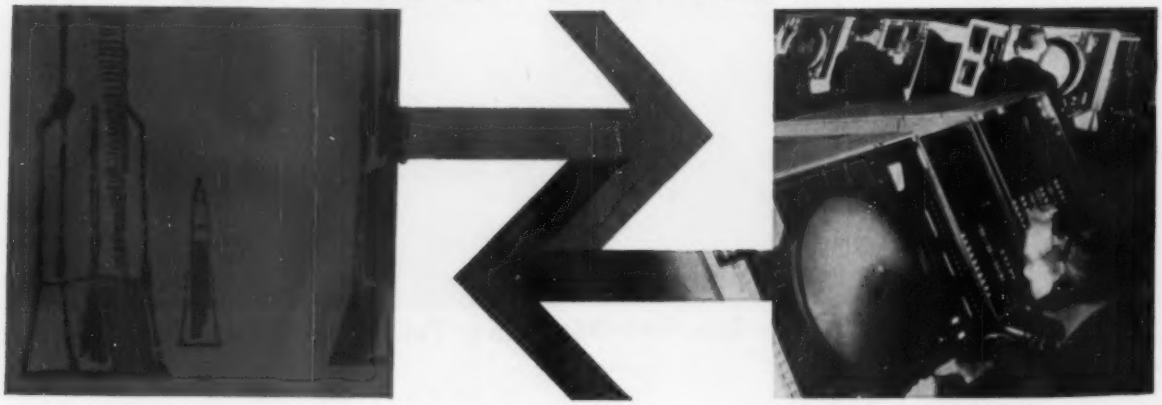
Satellite-Detecting Telescope Being Developed

Balloon-borne satellite-detecting telescope being developed by Electro-Optical Systems for USAF (AW Sept. 19, p. 37) has parachute for return to earth.





the elements of Command Control:



Data Acquisition and Application
The measure of any command control system is time. Success depends on how fast the system can close the loop between detected action and counter-action. Command control begins with data acquisition and ends with data application. Here, IBM's experience encompasses subsystems for the acquisition of information from distant and varied sensing devices, and for the presentation of refined data to commanders for military action.

Data Communication
High-speed networks that link command control computers require facilities to assemble and direct masses of data. Time is important. IBM data communication capabilities are evident in systems such as SABRE, a real-time activity control network; and INFORMER, a rugged, mobile field control center. These systems employ communication techniques involving real-time data channels, data conversion and message switching.

Data Processing and Control
Information must be quickly reduced and refined through computer processing to prepare it for command decision. Here again time is paramount. IBM has solved special data processing problems with standard systems such as the 709, installed for space vehicle orbit computations, and advanced systems such as the AN/FSQ 31V, in production for the Strategic Air Command Control System.

...all systems capabilities of IBM

IBM solutions to command control requirements range in scope from antisubmarine warfare studies to Air Force control systems like project 473L, and from the compact INFORMER to STRETCH, the world's largest computer. From study to implementation, IBM has proved its ability to solve the problem of time in all three elements of command control systems.

Federal Systems Division, 326 East Montgomery Avenue, Rockville, Maryland

IBM

Division, Vitro Corp. of America's Laboratories Division, Washington Technological Associates, Inc., Western Electric Co., Inc., and Winzen Research, Inc.

Space Consultants Appointed By NASA

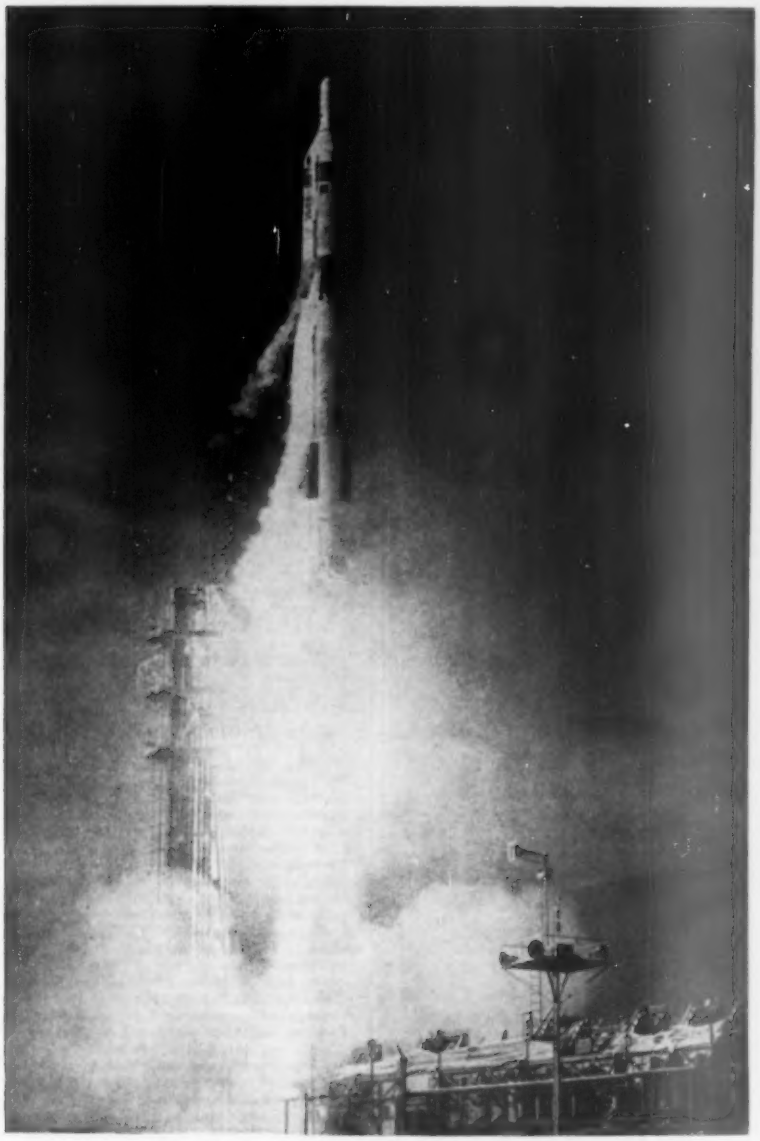
Washington—Twenty-five consultants have been named to advise the National Aeronautics and Space Administration in five areas of space science.

NASA said appointment of the consulting group of leading scientists had been planned for some time as part of the organizational structure of the Space Sciences Steering Committee. This committee has responsibility for selecting scientific satellite and probe experiments.

New consultants and the areas in which they will serve are:

• **Astronomy**—Dr. Dirk Brower, Yale University Observatory; Dr. A. Keith Pierce, associate director of solar astronomy, Kitt Peak National Observatory; and Prof. William F. Fowler, department of physics, California Institute of Technology.

• **Ionospheric Physics**—Prof. Robert A. Helliwell, department of electrical engineering, Stanford University; Dr. Hans Hinteregger, Air Force Research Division; Dr. Francis S. Johnson, Lock-



Titan-J ICBM Launched at Cape Canaveral

First successful launch of a USAF-Martin Titan-J intercontinental ballistic missile is shown at liftoff at Cape Canaveral, Fla. Missile was the 14th Titan to operate successfully in 20 launches. Shot was made 5,000 mi. down the Atlantic Missile Range.

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*by Dean S. Shiels**

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* * *

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heed Missiles and Space Division; Dr. C. Gordon Little, chief, Upper Atmosphere and Space Physics Division, National Bureau of Standards; and Prof. George W. Swenson, Jr., department of electrical engineering, University of Illinois.

• **Lunar Sciences**—Dr. Harrison Brown, department of geological sciences, California Institute of Technology; Dr. Maurice Ewing, Lamont Geological Observatory, Columbia University; Dr. Thomas Gold, department of astronomy, Cornell University; Dr. Harold H. Hess, geological department, Princeton University; Dr. Frank Press, division of geological science, California Institute of Technology; Dr. Gordon Tomkins, National Institute of Arthritis and Metabolic Disease, National Institutes of Health; and Dr. Harold C. Urey, Institute of Technology and Engineering, University of California.

• **Particles and Fields**—Dr. Kinsey A. Anderson, physics department, University of California; Dr. Eugene N. Parker, Enrico Fermi Institute for Nuclear Studies, University of Chicago; Prof. Bruno B. Rossi, department of physics, Massachusetts Institute of Technology; Prof. James A. Van Allen, department of physics and astronomy, State University of Iowa; and Dr. John R. Winckler, school of physics, University of Minnesota.

• **Planetary and Interplanetary Sciences**—Philip H. Abelson, Carnegie Institution of Washington, D. C.; Dr. J. W. Chamberlain and Dr. Gerard P. Kuiper, Yerkes Observatory, University of Chicago Joshua Lederberg, department of genetics, Stanford University; and Dr. Edward P. Ney, department of physics, University of Minnesota.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a listing of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Utica Division, The Bendix Corp., Utica, N. Y., product improvement, preproduction, testing and prototype for cartridge/pneumatic starters, type STU-11/A34 and data, contract AF 33(600)41997, $289,675.

Wright Aeronautical Division, Curtiss Wright Corp., Wood-Ridge, N. J., model R1820-82A engines for Navy 82F3 aircraft, 40 ea., supplement agreement eleven (11) to contract AF 33(600)40341, $1,627,120.

Convair Division, General Dynamics Corp., Ft. Worth, Tex., B-58A weapon systems composed of airplanes and two component pods, and data, letter contract AF 33(600)41891, $15,000,000.

Defense Products Division, Fairchild Camera and Instrument Corp., Syosset, L. I., N. Y., replacement spare parts for miscellaneous aerial reconnaissance equipment, contract AF 33(600)41788, $37,669.

General Electric Co., West Lynn, Mass., transmitterr, rate of flow, type TRU-7/A, 87 ea., contract AF 33(600)41851, $41,151.

X-Ray Department, General Electric Co., Milwaukee, Wis., spare parts for the 0-20, 0-22, KS-32 and C-7 cameras bodies and the LD-45A magazine (various quantities), contract AF 33(600)41656, $95,185.

Alkaline Battery Division, Gulton Indus-

tries, Inc., Lodi, N. J., nickel cadmium battery program, contract AF 33(600)41670, $46,544.

Collins Radio Co., Cedar Rapids, Ia., indicator, horizontal situation, type AGU-2/A, Aerno 60-6323, 150 ea., spare parts, ground support equipment and data, letter contract AF 33(600)41813, $219,131.

George V. Clark Co., Inc., Englewood, N. J., stock number 6760-290-8133, reel, photographic film, steel, enameled finish, 3,300 ea., stock number 6760-598-7276, reel, photographic film, steel, painted finish, 19,975 ea., stock number 6760-282-7988, reel, photographic film, PH-312, steel, E finish, 2,900 ea., stock number 6760-263-0130, can, photographic film storage, 7,960 ea., usage; ground support equipment, contract AF 33(600)41926, (IFB 33-600-60-223), $42,917.

John I. Thompson & Co., Washington, D. C., AF publications distribution program for fiscal year 1961, letter contract AF 33(600)38247, $721,000.

Servomechanisms, Inc., Hawthorne, Calif., transmitter, synchro, angle of attack or sideslip, Aerno 60-1602, 288 ea., and data, contract AF 33(600)41929, IFB 33-600-60-246, $109,728.

Airborne Instruments Laboratory Division, Cutler-Hammer, Inc., Deer Park, N. Y., radiometric mapping set AN/ARR-27(XH-1), test equipment, spare parts, flight tests and data for an unknown use, (PR 64430), $474,648.

Camera Equipment Co., Inc., New York, N. Y., ES-21 motion picture film editors, repair parts, and data for use as ground support equipment, (MIPR R60-32260-SC-24 and amendment 1, 2 and 3), $39,005.

Systems Development Corp., Xenia, Ohio, modification kit for camera simulator, P/N 14132, 36 ea.; modification kit for type E-1 amplifier tester, P/N 14477, 39 ea.; modification kit (cable attachment assemblies) for receiver assembly tester, P/N 14104, 75 ea., and data, contract AF 33(600)41946, $36,646.

AiResearch Manufacturing Corp. of Arizona Division, The Garrett Corp., Phoenix, Ariz., starters, engine, gas turbine, type STU-12/A34, AiResearch model ATSC 100-1-4, P/N 350950, Aerno 42-8754, installations for F-105D aircraft, 61 ea., and data, contract AF 33(600)41053, $274,517.

Flight Propulsion Division, General Electric Co., Cincinnati, Ohio, J79-GE-8 turbojet aircraft engines with afterburners, 94 ea., supplemental agreement number 3 to AF 33(600)38852, $21,150,000.

Vertol Division, Boeing Airplane Co., Morton, Penna., Vertol Model 44A helicopters, spare parts and ground support equipment, supplemental agreement number to 5 to AF 33(600)40443, $1,687,148.

X-Ray Department, General Electric Co., Milwaukee, Wis., spare parts for the C-3, C-7, ID-45A radar recording camera bodies and the C-11 and LD-45A magazines, contract AF 33(600)41819, $364,887.

Vickers, Inc., Torrance, Calif., starters, hydraulic, aircraft engine, type STU-9/A27, contractor's model EA-1030-070-2, Aerno 42-8900, 12 ea., and data, contract AF 33(600)41955, $38,666.

Defense Electronics Products Division, Radio Corporation of America, Camden, N. J., engineering services to support testing and installation of time division data link, 60 man months to be furnished at Convair Division, Palmdale, Calif., facility; 40 man months to be furnished at Boeing Airplane Co., Seattle, Wash., facility; eight man months to be furnished at the Philco Corp., Philadelphia, Penna., facility, letter contract AF 33(600)41688, $150,000.

Crucible Steel Company of America, Midland, Penna., D31 Columbium alloy program, supplemental agreemnt number two to AF 33(600)39942, $264,315.

Lockheed Aircraft Corp., Marietta, Ga., C-130 flight testing, maintenance and reports, contract AF 33(600)41546, $29,998.

Norair Division, Northrop Corp., Hawthorne, Calif., preparing facilities for shipment and providing facilities for various Air Force programs, contract AF 33(600) 41589, $26,100.

Federal Systems Division, International Business Machines Corp., Owego, N. Y., components of AN/ASB-9A bombing navigation system and spare parts, for B-52 Mod 1000 program, letter contract AF 33 (600)41839, $2,595,019.

Pioneer-Central Division, The Bendix Corp., Davenport, Ia., indicator Mach number, integrally lighted, type AVU-11/A in accordance with specification number MIL-I-27279(USAF), 1959, Aerno 60-0210, 27 ea., and data, contract AF 33(600)41973, IFB 33-600-60-247, $25,492.

Collins Radio Corp., Cedar Rapids, Ia., indicator, horizontal situation display, type AF/A24J1, Aerno 60-6308, 108 ea.; amplifier, horizontal situation display, Aerno 60-6315, 71 ea., contract AF 33(600)41844, $398,348.

John Oster Manufacturing Co., Racine, Wis., coupler, Tacan, contractor's P/N 9615-18,FSN 5826-674-3210, Aerno 81-3201, 53 a.; mountings, contractor's P/N C95635, FSN 5836-765-9606, Aerno 81-4396, 42 ea.; coupling unit, contractor's type number 9615-18, FSN 5826-674-3201, Aerno 81-3201, 125 ea.; spare parts, ground support equipment and maintenance data and engineering data, contract AF 33(600)41809, $319,019.

Bell & Howell Co., Chicago, Ill., anamorphic lens, size 2", contractor's design 921-B (B&H), FSN 6760-507-1324, 300 ea. and commercial instruction pamphlets, contract AF 33(600)41859, $41,310.

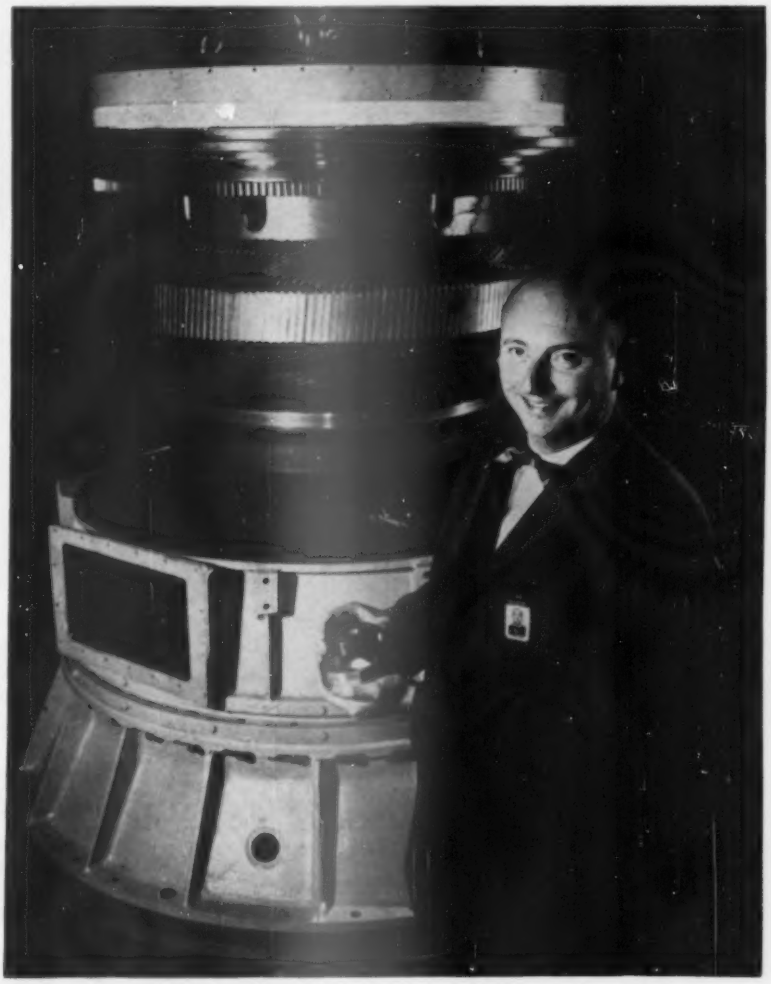
Dalmo-Victor Co., Division, Textron, Inc., Belmont, Calif., design, fabricate and test a new record playback head used with the signal data recording set, type A/A24U-C-3 and data, contract AF 33(600)41762, $58,397.

Magnetic Instrument Co., Inc., Thornwood, N. Y., indicator set, liquid oxygen quantity, type A/A24J-8, in accordance with specification MIL-I-27220A, (USAF) dated March 3, 1960, Aerno 46-1005, 50 ae., and data, contract AF 33(600)41852, IFB 33-600-60-233, $46,050.

Boeing Airplane Co., Wichita, Kan., engineering flight testing of B-52 series aircraft including supporting maintenance, modification and technical assistance, letter contract AF 33(600)41878, $61,550.

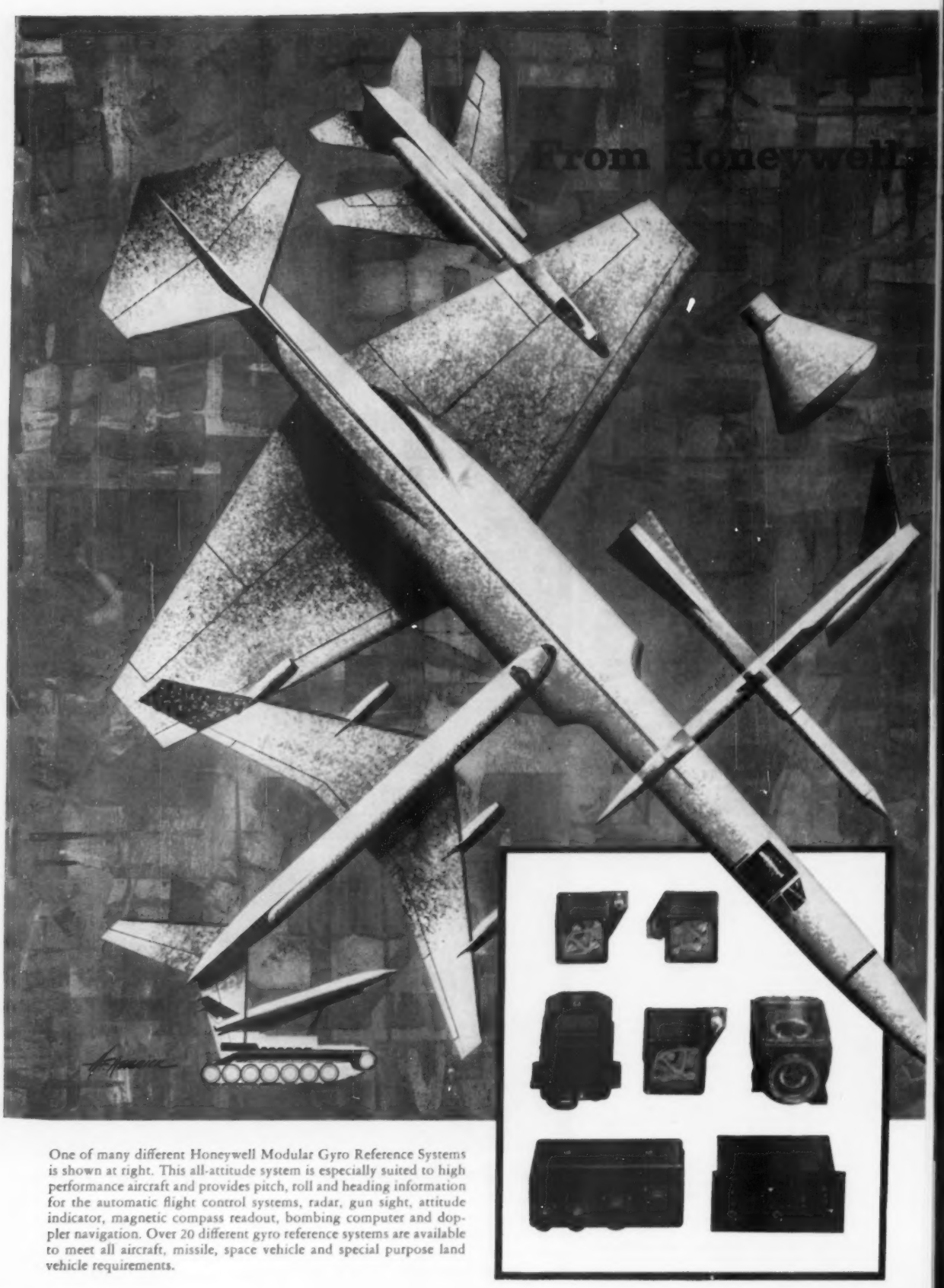
Federal Systems Division, International Business Machines Corp., Owego, N. Y., management-engineering services for AN/ASQ-38(V) weapon control system for B-52 aircraft, letter contract AF 33(600)41814, $460,852.

Sperry-Phoenix Co. Division, Sperry Rand Corp., Phoenix, Ariz., extension of time for support of drone testing modification and rework of AN/APW-22 transponders, supplemental agreement number six to AF 33 (600)39540, $151,912.



GE Develops Gearless Power Drive for Tartar

Fire control director of Navy's Tartar missile, installed aboard the USS C. F. Adams missile ship, is equipped with a gearless power drive developed by General Electric's Ordnance Department at Pittsfield, Mass. E. B. Canfield, co-inventor of the power drive, shows contrast between small drive motor used in Polaris missile and the large Mk. 73 drive motor in background. New system eliminates resonance and backlash.



One of many different Honeywell Modular Gyro Reference Systems is shown at right. This all-attitude system is especially suited to high performance aircraft and provides pitch, roll and heading information for the automatic flight control systems, radar, gun sight, attitude indicator, magnetic compass readout, bombing computer and doppler navigation. Over 20 different gyro reference systems are available to meet all aircraft, missile, space vehicle and special purpose land vehicle requirements.

A New Modular Concept for Gyro Reference Systems

Honeywell offers you over 20 new Modular Gyro Reference Systems to meet virtually *all* aircraft, missile, space vehicle and special purpose land vehicle requirements.

This versatile new family of Gyro Reference Systems is created from standard, off-the-shelf components, to offer great flexibility, proven reliability—and, fast delivery. Accelerometers, repeaters and control panels combine to give you the widest selection of gyro reference systems available anywhere. This means that you can select the exact system to meet your requirements without waiting for or paying for a long development period. Extensive field and laboratory histories on each of these Honeywell reference system components assure system reliability.

Here's what Honeywell's new Modular Gyro Reference System Concept offers you:

- **Minimum delivery time**
- **Lowest possible cost**
- **Elimination of structural problems encountered when gyros are combined on a single platform**
- **Maximum flexibility and packagability**
- **Ease of maintenance (through modular makeup)**
- **Less volume required through easy utilization of irregular space**

Typical systems available provide: Standard Attitude, True Heading Attitude, All-Attitude and True Heading Attitude, Multiple Output All-Attitude, and Low Drift Azimuth All-Attitude. Many others are also offered. These systems are applicable to a wide variety of vehicles ranging from commercial and military transport aircraft, to heavy tactical aircraft, high performance aircraft, missiles, space probes, and special purpose land vehicles.

With this new Modular Gyro Reference System Concept, you can choose from the following features to meet your exact needs.

Ready time—1/10 second from inert storage

Accuracy—to 0.1°/hr. drift

Gyro weight—as low as 2.8 lbs. each

Erection—to computed local vertical without Schuler loop

Freedom—360° continuous—all axes

Acceleration—to 90 G sustained

To obtain a copy of Honeywell's new book, "Gyro Reference Systems," contact your Honeywell representative; or write: Honeywell, Aeronautical Division, Dept. AW-9-167, 2600 Ridgway Road, Minneapolis 40, Minnesota.

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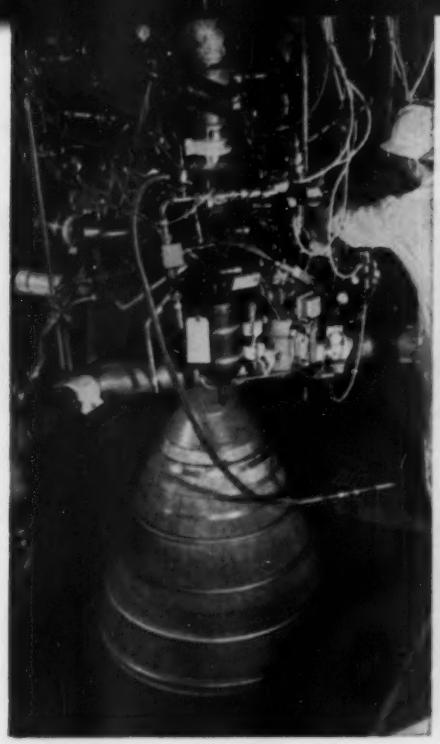
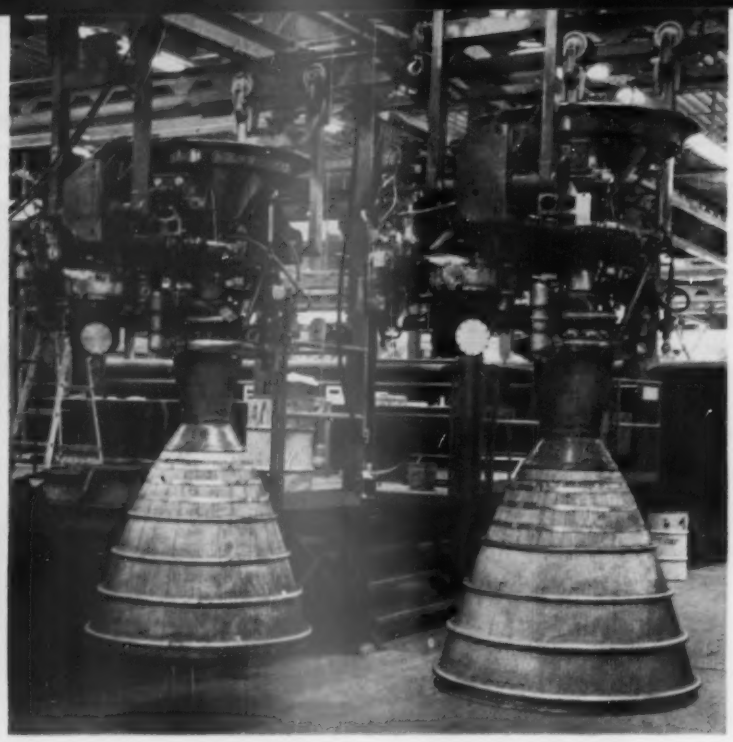
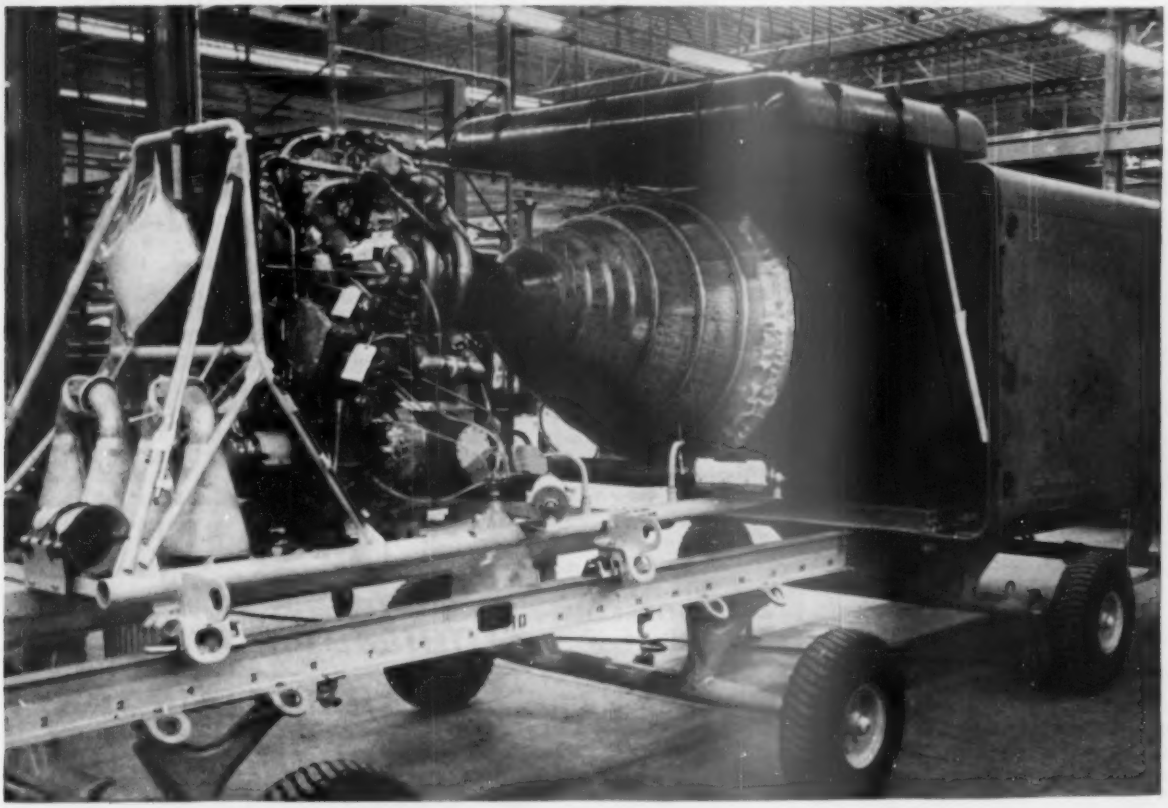




Titan Engines Reach Final Assembly at Aerojet Plant

Second stage engines for USAF-Martin Titan intercontinental ballistic missiles are shown on the assembly line at the Liquid Rocket Plant of Aerojet-General Corp. at Sacramento, Calif. Engine is being readied for a static test (above, left). Two engines at top right are in the final assembly area for checkout prior to packing for shipment. Second stage is loaded into its container (below). Engine delivers 80,000 lb. thrust.



FLY WEATHER-WISE

These weather items prepared in consultation with the United States Weather Bureau

FLIGHT PLANNING

CEILINGS AND VISIBILITY

The Civil Air Regulation's "Visual Flight Rules" state that all VFR flights must remain clear of clouds—1000 ft. above, 500 ft. below, and 2000 ft. horizontally in uncontrolled air space. An altitude of 700 ft. or more must be maintained in control zones (near airports) and control areas (along airways). Ceilings of 1000 ft. are required in control zones. In continental control areas cloud clearance must be 1000 ft. above, 1000 ft. below, and 1 mile horizontally.

IN planning VFR flights, you must determine that visibilities along your proposed route are at least 1 mile at all times—3 miles in control zones and control areas and 5 miles in continental control areas. This can be done in the following ways: consult your local Weather Bureau office and check latest weather reports; check latest forecasts and compare with preceding ones to judge trend; look for special advisories, pilot reports (PIREPS); note frontal weather near your flight path—even weak fronts can cause problems later during flight; study terrain—ceilings that appear high enough to permit flying underneath may not allow you to clear mountains. Remember, haze, smoke and precipitation—especially snow—may reduce visibility below VFR limit. Keep tuned to area FAA—FLIGHT SERVICE Stations for up-to-date meteorological reports and Flash Advisories.

If weather at your destination appears questionable, pick an alternate in a different air mass or weather regime. Also, check the winds aloft, and make certain that you will have sufficient Mobilgas Aircraft to reach your alternate.

* * *

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Business Pilots Need Executive Ability

By Herbert J. Coleman

Millville, N. J.—Today's business and executive pilot is going to have to be just that—all business and good bit of the executive.

That was the concensus of top professional business pilots at Airwork Corp.'s annual Operations Symposium here. The pilots, they felt, have reached a level of corporate responsibility that virtually demands that they head up a well-run, efficient department that can show its dollar value to the owners.

As E. Tilson Peabody, chief of General Motors' executive fleet (five Allison turboprop-powered Convairs) put it:

"Today's pilot decisions can markedly affect the future of his company if he is not conducting his operation with the maximum of efficiency and safety.

"Pilots now are growing up to be managers, developing sound business principles—and that means no kickbacks from the suppliers. He must be critical of his suppliers, if necessary, and above all he must stand for no sloppiness in any phase of his operation."

Complex Aircraft

The pilot is faced with increasingly complex aircraft, Peabody noted, and he warned that with advancing technology the pilot must give far more detailed attention to his own knowledge and to his crew training program.

Referring to aircraft complexity, Peabody said the day is not far off when owners of larger business airplanes, particularly turbines, will find it necessary to add a third man to the flight deck, primarily responsible for maintenance and ground handling.

This will be necessary chiefly because fixed base operators are still relatively unfamiliar with turbine aircraft and their fueling and handling problems, according to Peabody.

However, Charles Morris, of Socony Mobil, disagreed with this philosophy, contending that the ground handling job is the primary responsibility of the pilot and copilot and should be handled by them alone.

Executive Capability

Turning to executive capability demanded of today's pilots, Morris said "management has learned a lot about business flying, and its hard to snow them any more." Pilots, he said, must be able to explain equipment, purchases and operational needs to management in dollars and cents terms, particularly in this age of highly complex avionic and radar systems needed for a true all-weather operation.

"No executive wants to schedule a meeting in Chicago and find himself in St. Louis as an alternate," Morris emphasized. "Because of this, the business pilot must know what his company demands, what kind of equipment will fill that demand, and how to obtain it as the best possible price."

Sound planning, safety and comfort is the basis for any good business flying operation, according to Earl Bauer, assistant to the manager of aviation of Ohio Oil Co. In addition, the pilot now is faced with complicated bookkeeping, not only in his operational purchases, but in his maintenance records and history, he added.

"Management expects the business pilot to run his operation exactly in the manner of any other corporate department—efficiently. The day of the pilot as the fair-haired boy of the company is done.

"The program of running your maintenance in Florida in the winter and in the northern lake country in the summer is a planned program all right, but only for the people involved—not the company," Bauer said.

Best bet, the pilots agreed, is a continuous exchange of information among business pilots, to keep up a knowledge of trends in research and development. Another is a constant analysis of the pilot's particular flight operation and its inherent problems.

In a discussion of fixed base operators, Robert B. Olsen, of National Lead Co., made these points as a starting point for better relations between the operator and the flight crew:

- **Pilots should brief** the operator on his plane's maintenance history and should make his work order as complete and concise as possible.
- **Assign a crew member** to the job as an overseer, if possible. This is of utmost value in the "sight-unseen" jobs that can crop up in an overhaul.
- **Don't contract** for an engine overhaul and then decide at the last minute to modify the landing gear, still expecting the same downtime.
- **Make a firm contract** or work order, inspect the work in progress, and "don't make any deals on the side."

For fixed base operators, he suggested:

- **Don't promise** what you can't do.
- **Require complete authority** under a contract or work order.
- **Give the pilot a free,** itemized accounting of all time and materiel.
- **Be fair.** "We all realize that the fixed

Silver Sixty B-26 Conversion Starts Tests

Flight tests of a deep fuselage conversion of a surplus Douglas B-26 (AW July 27, 1959, p. 93) have been started at Los Angeles, Calif., by Rhodes Berry Co., the designers. Company said main purpose in the belly modification is to allow passengers standing room and added comfort. Plane, designated the Silver Sixty, can seat 14 passengers; Rhodes Berry hopes to sell it as a military transport to South American republics in 20-troop configuration. Engines are Pratt & Whitney R-2800s.

SIXTH ANNUAL
Aviation Week

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GUIDE ISSUE

AVIATION WEEK's Annual Buyers' Guide is one source for buying information in all segments of the dynamic aerospace industry. It's on the engineer's desk...at his fingertips...readily accessible...with needed information.

The new 1961, 6th Annual Edition, now in preparation, is more complete and essential than ever before, containing expanded listings on new products and companies in new areas of the total market.

It will contain over 50,000 manufacturers' product listings in 1,800 product categories. In addition to being quick and easy to use, the BUYERS' GUIDE includes complete listings of government procurement agencies telling: Where to go; Who to see; What they buy.

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PUBLISHING DATE: Mid-December

CLOSING DATE: November 15, 1960

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Aviation Week and Space Technology

ENGINEERING
REPORT
ON BENDIX COMPONENTS

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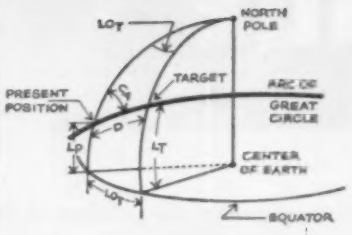


PROBLEM: Design a computer to provide an aircraft with continuous bearing and range information along the arc of a great circle.

C_A—Bearing

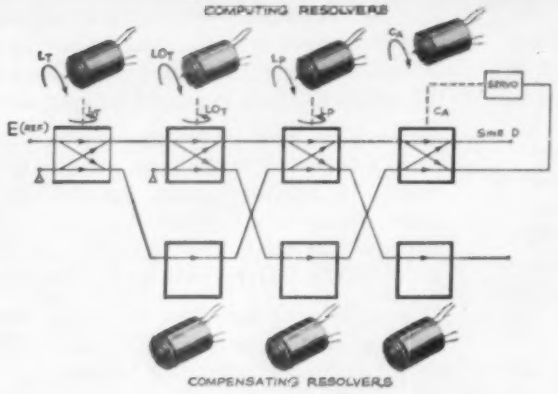
LO_T—△Longitude measured from present position to target

L_P—Latitude of present position

L_T—Latitude of target

D—Great Circle distance from present position to target.

SOLUTION



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The Bendix Corporation

District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C.
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

base operator is not running a charity organization, but must make a profit to exist."

Having the flight operation's representative on the job is of prime importance, Olsen said, "since he not only knows the airplane but he can also watch the billing."

Job Deadline

Speaking from the air carrier angle, W. F. (Bill) Davis, of Piedmont Airlines, said he "knows the fixed base operators have their problems, but we have an airline to run." He recommended finding the exact costs, getting a downtime deadline and "talk the job over to see that you get the entire job done." He also stressed:

- **Be sure the fixed base operator** can back up his work and get Federal Aviation Agency approval on the job.
- **Get the job in writing** and furnish drawings to the base, if needed.
- **Set your standards high** and see that the fixed base operator lives up to them.

Turning to the field of "do-it-yourself" maintenance as against farming it out, Arnold Haines, of Bethlehem Steel, said his company has found considerable savings and quality control by running its own flight maintenance base. Bethlehem adopted that system 14 years ago.

He said this system allows planned programs of inspection and maintenance, no delays in maintenance projects and standardization of parts and controls ("How many times have you climbed in your airplane after a repair job and found that the switches have been moved?").

Cost Analysis

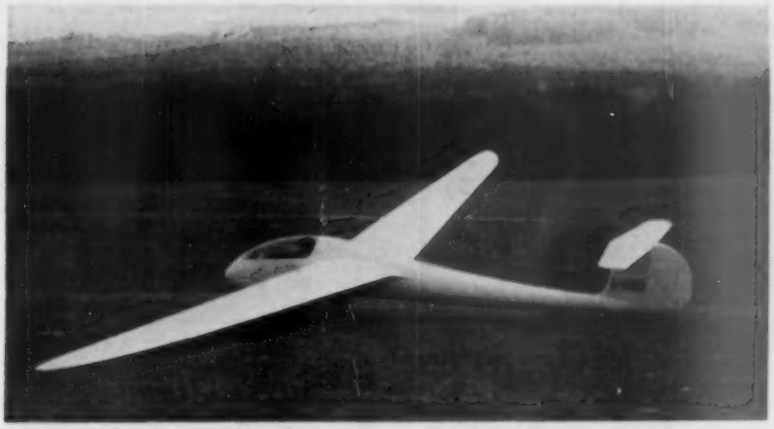
Cost analysis has shown that self-maintenance is more convenient and is "cheaper and better," according to Haines.

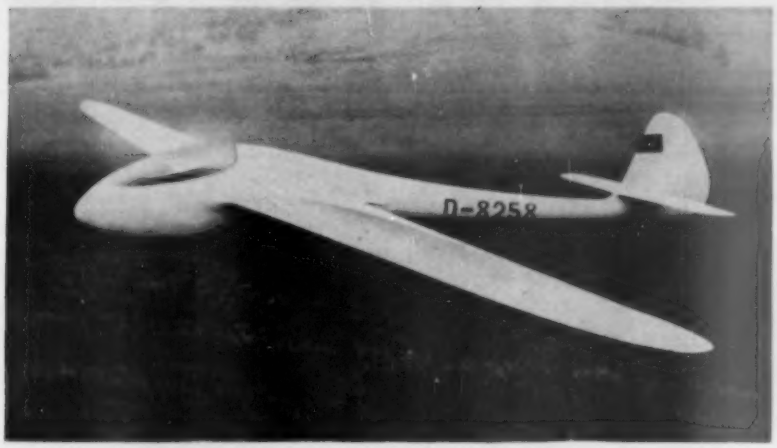
This brought a sharp denial from Norman Moorehouse, of American Airmotive, who said "regarding the cost picture, I think we can provide lower cost on both volume business and in customer services. As far as quality control is concerned, the fixed base operator is just as concerned about his standards as is the owner-operator."

Increasing importance of the turbine engine to business flying dominated most pilot shoptalk at the symposium. For some, like General Motors, it now is a way of life, but for the smaller operators like Lake Aircraft Corp., manufacturer of the Lake Amphibian, it is like the shiny package at the top of the Christmas tree.

Said John F. Strayer, Lake Aircraft president:

"We have made preliminary design plans on installing a turbine on our Amphibian, and we think it will work fine. But it is a question of being first and being a hero, or staying in business. At





Germany's Phoenix Glider

Modified T-tail version of the German all-synthetic Phoenix FS 24 glider was flown by the 1958 open class world champion at Leszno, Poland, Ernst-Gunter Haase of Germany, into ninth place at the recent Eighth World Gliding Championship at Butzweiler, West Germany (AW July 18, p. 102). Span is 52.5 ft., length 22.4 ft., wing area 154.5 sq. ft. First prototype Phoenix (below), designed jointly by Dipl. Ing. Nagele and Dr. Eppler of the Technical College, Stuttgart, was introduced at the German Glider Competition held last summer at Karlsruhe-Forchheim. Production is now in the hands of Apparatebau Nabern GmbH., Nabern/Teck, an associated company of Bolkow-Entwicklungen K. G., Munich.

the moment, we prefer to stay in business."

Strayer, of course, spoke for the Amphibian. Turbines are of vital importance to larger companies, particularly in the twin-engine field, which must remain competitive in a time of galloping powerplant technology.

PRIVATE LINES

Super-V Twin-engine conversion of the single-engine Bonanza manufactured by Bay Aviation Services Co. (AW Aug. 22, p. 107) will make a round-the-world solo flight starting from Honolulu, Hawaii, on Oct. 15. The Super-V route from Honolulu will be to Oakland, New York, Gander, London, Rome, Beirut, Karachi, Calcutta, Bangkok, Singapore, Manila, Tokyo, Wake Island and return to Honolulu about Oct. 25. First two production models of the Super-V have been certificated by Federal Aviation Agency and will be used as demonstrators at Hope, Ark., and Oakland, Calif., company headquarters. Six more are on the production line.

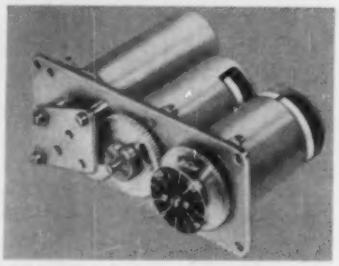
New Beechcraft Super G18 twin and an H50 Twin Bonanza have been purchased by Ralston Purina Co., of St. Louis, Mo. Chief pilot is Armond Hinkle; other pilots are Harry F. Tidler and James C. Doyle. In an overseas move, Beech said its distributor in the British Isles will be Short Bros. & Harland, Belfast, in conjunction with Aircraft Associates, Ltd.

McDonnell Aircraft Corp. has selected Remmert-Werner, Inc., St. Louis, to design and install an executive interior in its new McDonnell 220 jet transport.

ENGINEERING
REPORT
ON OTHER BENDIX COMPONENT PACKAGES

OMNI-BEARING CONVERTER

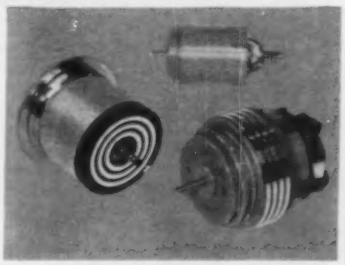
Modular package permits smaller, lighter navigation receiver design



Compass heading and VOR signals are computed and converted by this radio receiver component into signals that position the displays in the Radio Magnetic Indicator of an aircraft radio navigation system. In a package measuring only 3 5/8" x 2 1/8" x 1 1/2", the module comprises a size 11 resolver, differential, motor-generator, gear train assembly and indicator dial. Write today for complete information.

SYNCHRO SLIP RINGS

Autosyn® provides electrical contact with both rotor and stator



In the compact Autosyn design, both housing and shaft can be rotated, permitting introduction of another variable into the system. Electrical contact with both elements is made through external slip rings, which replace the usual fixed leads or terminals. Slip ring location and configuration can be varied to meet specific mechanical or electrical needs. Precious metals are used in the rings to minimize contact resistance and insure maximum reliability. Write for details. ®REG. U.S. PAT. OFF.

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RADAR DEVICES • INSTRUMENTATION
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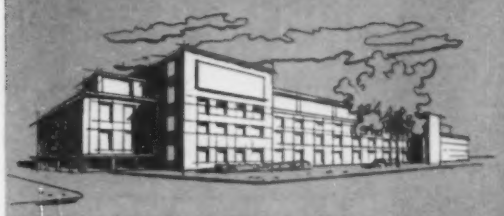
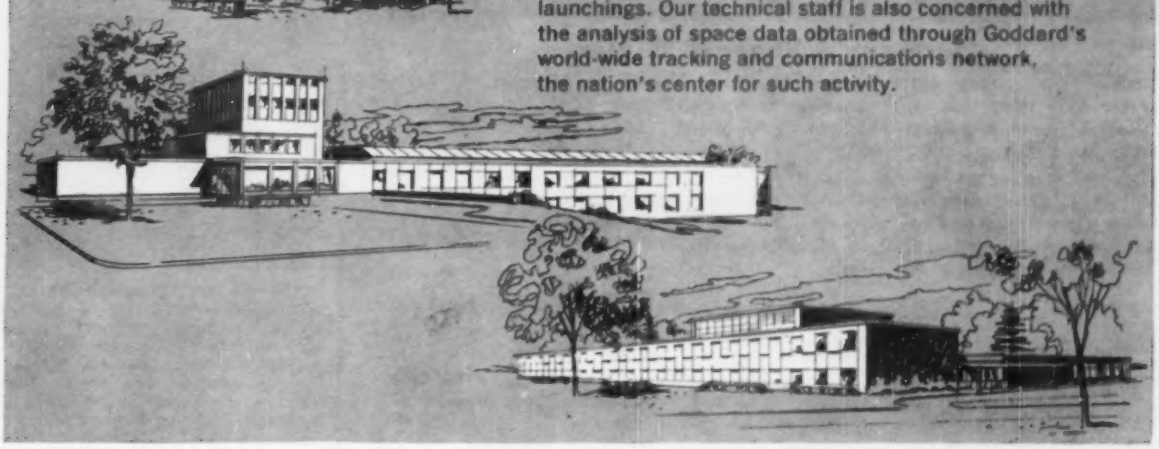


For deeper knowledge of our earth and nearby space, the moon and planets, interplanetary space and distant galaxies . . .

NASA introduces the new

GODDARD
Space Flight Center

The Goddard Space Flight Center has just occupied an ultra-modern research complex situated on 550 acres of rolling parkland in Greenbelt, Maryland, a residential suburb of Washington, D.C. Here, many of our scientists and engineers work to advance space science and technology through a broad program of theoretical study, while others design, develop and construct scientific payloads for space vehicles and supervise their launchings. Our technical staff is also concerned with the analysis of space data obtained through Goddard's world-wide tracking and communications network, the nation's center for such activity.



With Tiros, Echo, Pioneers IV and V, Explorer VII, and Project Mercury, Goddard has already written scientific history. Technical men who wish to work in the van of progress are invited to join Goddard or any of the other NASA research centers listed below. Address your inquiry to the Personnel Director.

NASA

National Aeronautics and Space Administration

NASA Goddard Space Flight Center, Greenbelt, Md. • NASA Flight Research Center, Edwards, Calif.
NASA George C. Marshall Space Flight Center, Huntsville, Ala. • NASA Wallops Station, Wallops Island, Va.

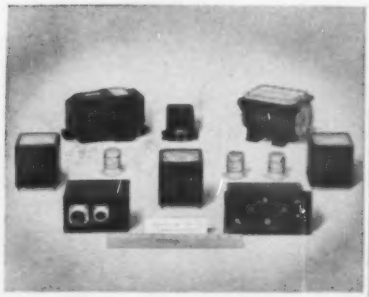
Trend toward small and compact yet modern design in aircraft terminals for relatively small cities is typified in this new building at Klamath Falls, Ore., in which costs were kept to $11 per sq. ft. through use of glued laminated Douglas fir members in the skeleton framework for columns and beams. Building was designed by architectural firm of Morrison, Howard & Starbuck, Klamath Falls.

Laminated Fir Keynotes Small Terminal Design

No posts are required in the building, due to use of heavy laminated beams. Restaurant, lounge and kitchens are on the balcony level; balcony is suspended from the roof beams by steel rods. Total volume is 106,000 sq. ft. Wall areas are mostly of glass.

Pioneer the future at

Honeywell Aero



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BSEE, MSEE, or BS or MS in physics to work on systems for space vehicle control and development of components for space vehicle equipment. Experience in any of the following fields desired: guidance and control systems; satellite development; systems management; ground to space communications; telemetery; space environment; ground computation and data processing; overall systems knowledge and understanding.

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BSEE, MSEE, Physicists or Astro Physicists to work on component applications for space vehicles. Experience in digital computation, transistor circuitry, gyro development and background in miniaturization and reliability controls desired.

To discuss these or other openings, write Mr. James H. Burg, Technical Director, Dept. 813, Aeronautical Division, 1433 Stinson Blvd., Minneapolis 13, Minn.

Honeywell

Military Products Group

To explore professional opportunities in other Honeywell operations, coast to coast, send your application in confidence to H. K. Eckstrom, Honeywell, Minneapolis 8, Minn.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Dr. Francis S. Johnson, manager of Lockheed's space physics research, has been appointed a consultant to the National Aeronautics and Space Administration, Washington, D. C. Dr. Johnson was the only scientist selected from private industry; he will serve on the ionospheric physics panel.

Changes

Ray L. Hixson, director of engineering, Arnoux Corp., Los Angeles, Calif.

Calvin C. Weigold, plant manager, Reed Instrument Bearing Co., Los Angeles, Calif., a division of SKF Industries.

George Kappelt, director of engineering laboratories, Bell Aerosystems Co., Buffalo, N. Y. Also: **Dr. Saul Barron,** head of the newly established Bell research department to conduct studies in major aerospace problem areas.

Herbert L. Karsch, manager, Space Technology Operations' Space Systems, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Dr. Zvi Prihar, assistant director of telecommunications, Page Communications Engineers, Inc., Washington, D. C., a subsidiary of Northrop Corp.

Kenneth Hudson, manager, Countermeasures Department, Raytheon Co.'s Santa Barbara, Calif., operations.

Harold L. Jarchow, manager, advanced engineering, North American Aviation's Columbus, Ohio, Division, and **James T. Overbey,** manager, advanced products.

Robert J. Geis, director of executive aircraft sales, Air Carrier Service Corp., Washington, D. C.

Joseph W. Baird, eastern military sales representative, Washington, D. C., for Lockheed Aircraft Service, Ontario, Calif.

Dr. Charles R. Kelley, director-experimental laboratory, Dunlap and Associates, Inc., Stamford, Conn.

Jerome S. Goldhammer, manager-reconnaissance systems and planning, Chicago Aerial Industries, Inc., Barrington, Ill. Also: Arthur R. Fichter, director of western operations; James H. Thompson, director of customer relations.

Robert M. Benson, chief engineer, Burton Manufacturing Co.'s Instrument Division, Santa Monica, Calif.

Alfred H. Norling, director of air transportation, United Research, Inc., Cambridge, Mass.

Capt. Frank G. Marshall (USN, ret.) special assistant to the vice president for information control center planning, Space Electronics Corp., Glendale, Calif., and **Alfred B. Hunter,** manager of customer liaison.

David S. Smith, Los Angeles (Calif.) district manager, Clevite Transistor Products, Waltham, Mass.

Michael Hacskaylo, director of research, Semi-Elements, Inc., Sexonburg, Pa.

Clinton B. McKeown, general manager B. F. Goodrich Aviation Products Division, Akron, Ohio.

Michael A. Corba, chief operational indoctrination pilot, Norair Division of Northrop Corp., Beverly Hills, Calif.

John F. Allen, manager-product development, Beech Aircraft Corp., Wichita, Kan.

Dr. Richard T. Eppink, has joined the technical staff of National Engineering Science Co., Pasadena, Calif.

Lane Upton, manager of contract development, Delcon Corp., Palo Alto, Calif.

Dr. Alden Stevenson, director of Research, Pacific Semiconductors, Inc., Culver City, Calif., a subsidiary of Thompson Ramo Wooldridge.

Ralph V. Barnet, director of marketing, General Precision, Inc., New York, N. Y., a subsidiary of General Precision Equipment Corp.

Donald D. Mallory, manager of product operations, Components Division, Hughes Aircraft Co., Culver City, Calif.

Virgil Steinmeyer, product manager, the Electric Autolite Co.'s Wire and Cable Division, Port Huron, Mich.

Charles E. Sporck, transistor plant manager, Fairchild Semiconductor Corp., Mountain View, Calif., a subsidiary of Fairchild Camera & Instrument Corp. **Dr. Harry Sello** succeeds Mr. Sporck as manager of the manufacturing department.

C. R. Bullock, southwestern district manager-field sales operation, General Electric Co.'s Flight Propulsion Division, Cincinnati, Ohio.

Dr. E. John Whitmore, manager-development engineering, Sylvania Electric Products' special tube operations, Williamsport, Pa.

Carl G. Gottlieb, manager, Armament Division of Universal Match Corp., St. Louis, Mo. **Max E. Norman** succeeds Mr. Gottlieb as head of the avionics and electronics department.

Albert N. Beseick, eastern regional sales manager, Bendix Filter Division, The Bendix Corp., Madison Heights, Mich.

James E. Borendame, director of marketing and public relations, Fansteel Metallurgical Corp., North Chicago, Ill.

Emmanuel P. Courtillot, director of European Planning for Varian Associates, with offices at Zug, Switzerland.

Wilbert W. Toole, manager of electronics and support systems, Customer Service Division, McDonnell Aircraft Corp., St. Louis, Mo.

Col. Frank J. Shannon, Jr. (USAF, ret.), manager of the Washington, D. C. District of the W. L. Maxson Corp.

N. W. Tillinghast, VTOL Engineering manager, Aeronautics Division, Chance Vought Aircraft, Inc., Dallas, Tex.

Kenneth Hudson manager, Countermeasures Department, Raytheon Co.'s Santa Barbara, Calif., operations.

B. William Miller, manager of marketing, and **Robert G. Evans,** manager of prototype fabrication, Space Technology Operations, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif. Also: **Dr. Elliott L. Katz,** senior staff specialist in Space Technology Operations' Missile Defense Activity.

Lt. Cmdr. Raymond T. Diedrichsen, (USN, ret.), Sonar Program supervisor, Southwestern Industrial Electronics, a division of Dresser Industries, Houston, Tex.

Jack B. Lindsey, marketing manager, Microdot, Inc., South Pasadena, Calif.

Albert E. Kelcher, Jr., director, Systems Marketing Division, Laboratory for Electronics, Inc., Boston, Mass.

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This career position requires experience in the field of noise reduction. Varied duties include measurement of data through design of acoustical treatments for aircraft, and the operation of noise reduction research programs.

Each of these positions requires an appropriate academic degree plus directly related experience, and offers an attractive salary. Call KIngswood 3-4000, write or forward your resume in complete confidence to:

M. Adelberg

Supervisor of Personnel Relations

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LETTERS

Soviet Space Shots

The long silences between USSR efforts at placing various vehicles in orbit has led me, in the past weeks, to search for clues as to organization of their plans for the space research in which they choose to indulge. The first step was to plot the weight of payload orbited about the earth or other celestial bodies vs. time. On this same graph a time scale indicates each of the successful launches with which we are now well acquainted.

Consider now the intervals from Sputnik I to Sputnik III, from Sputnik III to Mechta I, from Mechta I to Mechta II, and from Mechta II to Sputnik IV. These intervals are 7 months, 7 months, 8 months, and 8 months respectively. (As a side note, observe the two year anniversary shots of Mechta III, Oct. 4, 1959, and of Sputnik IV, May 14, 1960, i.e., two years after Sputnik III. Observe the average weight for Sputniks I, II, III; this is about 1,400 lb. Approximately three times this weight yields the weight of each Mechta (lunar shots) of some 3,400 lb. Three times the weight of a lunar vehicle yields the weight of the recent Sputniks IV and V. Thence, one could predict a 30,000-lb. payload to be launched in, say, seven months—late December or early January.

Suppose we reflect further; the lunar vehicles reached a velocity of some 36,000 ft./sec. at burnout. If the excess velocity over that necessary for orbiting the earth in a nominal 300-mi. orbit is subtracted from this lunar velocity requirement we have an excess of 11,000 ft./sec. There is a commonly used exchange in various studies for a fixed configuration of allowing, say, n ft./sec. instead of 1 lb. of payload. Suppose we choose for the Mechta booster 1.5 ft. per sec. per lb.; we exchange the 11,000 ft./sec. for 7,400 lb. of payload. Add this figure to the 3,400-lb. Mechta payload and we arrive at approximately a 10,000-lb. payload for Sputnik IV and for Sputnik V.

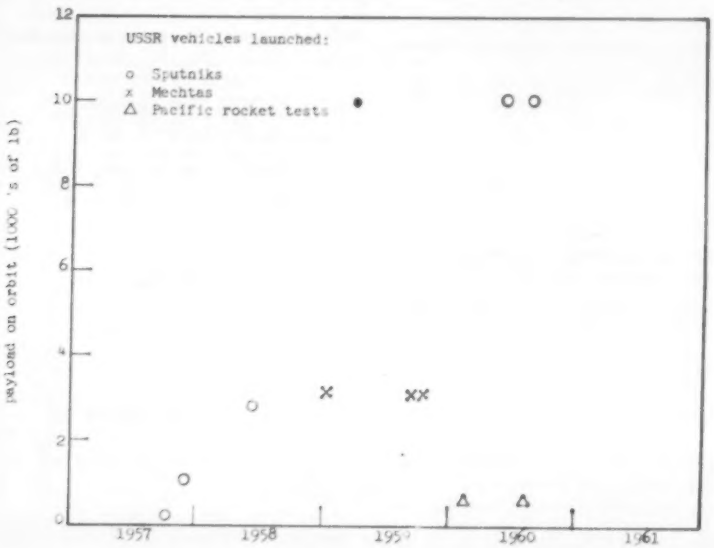
Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

If this is so, then the same basic booster was used for all three lunar shots and Sputniks IV and V. Carrying this line of thought further along, the ratios indicated previously may not present the correct viewpoint. It now appears that the latter five vehicles, when compared to the average of the first three, yield a ratio of about 10. Consequently, we should adjust our predicted January, 1961, launch to bear a payload of 100,000 lb.!

The remarks of Mr. Khrushchev at Helsinki lend credence to this hazardous prognosis. It might be asked why should the ratio change now (for January, 1961)? We believe that the recent shots into the Pacific were tests for the next generation booster and that the thrust of the first stage of that booster is at least 1,000 metric tons, i.e., 2.2 million lb. Now such a vehicle will not place 100,000 lb. on orbit in a single shot but two or three such boosters should accomplish the task. And Mr. Khrushchev said his 60-ton satellite would be orbited "like a train"-orbital assembly? We expect that this will be the man-in-orbit attempt expected everywhere and eagerly awaited in many quarters.

Since one of the rather few optimal times for launching a Mars vehicle will be at hand in early October, we can expect the USSR to launch a Mars probe at that time. Its payload should be of the order the lunar vehicle, 3,400 lb., because the velocity requirements are similar.

S. B. Kramer
Missiles Systems Division
Lockheed Aircraft Corp.
Sunnyvale, Calif.



Space Power

Your two-part report on the Air Force Space Vehicle Power Program by Mr. Philip J. Klass which appeared in the Aug. 15 (p. 83) and 22 (p. 69) issues is an excellent piece of reporting. Your organization must have expended considerable effort in digging out and organizing a tremendous number of facts.

The Advanced Systems Application Department of which I am a member deals directly with this area and I am requesting permission to reproduce the report for the information and education of our personnel. In addition, may I compliment you and your staff for producing what is undoubtedly the outstanding magazine in its field.

J. W. Brindley
Advanced Systems Application
Aircraft Equipment Department Sales
Westinghouse Electric Corp.
Lima, Ohio

Cancellation Delay

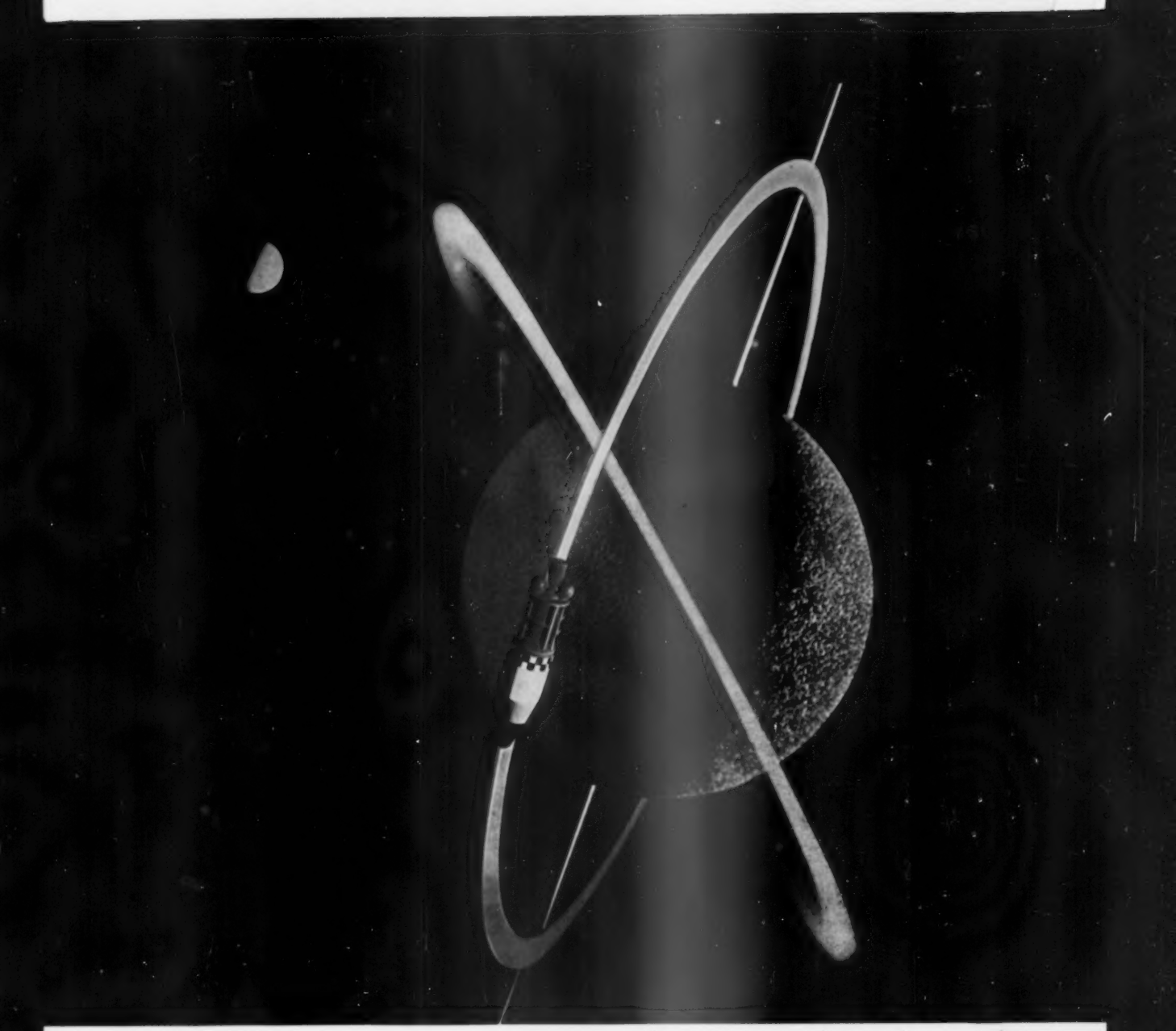
The domestic airlines complain constantly about the problem of no-shows. Certainly it is a major economic factor for them. Yet it seems to me that they have failed to take at least one simple and inexpensive step that would go a long way toward reducing the problem.

The delay—and resulting irritation—in trying to reach a reservation clerk to phone in a cancellation is such that many people just conclude it isn't worth it. As a case in point, I found last evening that I had to cancel a trip for today. I didn't phone in my cancellation immediately because I've been stung too often on a toll call from my home in Norwalk, Conn., running to $1 or more by the time I could get a message through. I tried calling from the train station this morning, and after using my second and last dime to keep the line open from the pay station, had to give up. I put a stopwatch on a call from my office, and it was 4 min. 50 sec. from the time the airline office answered until I got a clerk to take a 10 sec. message: "Cancel Boyce on your Flight 382 of today from La Guardia to Keene."

How simple it would be to have a separate phone number for cancellations, with a recording device to take down the information. Or, if the volume doesn't justify a second line, have the operator ask, "Do you wish reservations or cancellations?" when she answers, instead of always saying, "Reservations are busy. Will you wait, please?" If the customer says, "Cancellations," she could say, "Your information will be recorded as soon as you hear the tone signal; please record your phone number if you wish us to call you back about rescheduling your trip."

Cost would be minor. The public relations gain would be substantial. And I'd make a small bet it would improve the no-show problem.

Carroll W. Boyce
Chief Editor
Fleet Owner
New York, N. Y.



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Vast sums of money and vital scientific data ride on these built-in attributes of Bell Aerosystem's rocket engine for Lockheed's Agena satellite, second stage of the Air Force Discoverer series.

The Agena engine, designed with space in mind long before space became a household word, has fulfilled its every mission and has placed more tons of useful payload into orbit than any other power plant. Its operational reliability is backed by six years of development and 5,000 test firings.

This Bell engine now has re-start capability — the first in the nation. This means that its satellite can change orbit **in space** without the penalty of extra engines. Presently in production, this engine also is adaptable to new fuels and new assignments and, consequently, is programmed for important military and peaceful space ventures of the future.

Agena's engine is typical of the exciting projects in Bell's rocket propulsion center. It is part of the dynamic new approach of a company that's forging ahead in rocketry, avionics and space techniques. These skills serve all government agencies. Engineers and scientists anxious for a new kind of personal challenge can find it at Bell.

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